THE TELEGRAPHIC JOURNAL AND

# Electrical Review.

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## "WHEN DOCTORS DISAGREE!"

UNLESS he ignores contemporary literature, and this he cannot afford to do, the student of *steam* must by this time be in an awkward dilemma. If he has studied the contradictory and sometimes ludicrous statements put forth by several of our leading technical journals, some in support of and others against certain principles involved in the Marchant engine, the student may henceforth look upon his text books and teachers with a sceptical eye. On the other hand, and this is the most likely course he may adopt, for obvious reasons, if he holds on to his old and universally recognised authorities, he will regard some of the elaborate newspaper articles and letters which have recently appeared, as so much "chaff." The importance of the subject is evidenced by the large amount of attention, adverse though it may be, it has received, and we have the satisfaction of having initiated a great controversy which must bring about some good, if only by ventilating opinions.

No one up till now has been able to disprove the figures which we have given concerning the performance of the Marchant engine and we shall stand by them until we may have just cause to modify any of our statements. In order to show what a variety of opinions may be set up by different "experts," we propose to quote a few passages from certain journals in rotation as they appeared.

*Industries* of September 17th, awaiting the results of another inspection, is "in a position to throw some light on the thermo-dynamic processes involved, and to show that there is a sound theoretical basis for the inventor's ideas as embodied in the engine." Then it quotes no less an authority than Professor Zeuner, who, twenty years ago, in his well-known work on the "Theory of Heat," pointed out a possible method of improving the efficiency of the steam engine almost identical with the method since adopted by Mr. Marchant. The detailed description quoted from Zeuner we need not repeat here, but the concluding remarks of *Industries* are of some consequence. There it says, "We should, therefore, expect a gain in efficiency with Marchant's arrangement to be somewhat smaller than that indicated by theory, and which has been investigated by Zeuner. In his book there will be found a table giving the gain in efficiency by using a perfect cycle under certain conditions, and for steam pressures varying up to 150 lbs. per square inch. The maximum (obtainable with a non-condensing engine working with 150 lbs. steam) is about 19 per cent., that is to say, the engine working with a perfect cycle will use 19 per cent. less fuel than an ordinary engine. With condensing engines the margin for economy is considerably smaller; but, on the other hand, the margin increases with the pressure, which in the case of the "Marchant" engine is 250 lbs. Taking into consideration the fact that the improved cycle in that engine only applies to two-thirds of the steam, the economy cannot much exceed 20 per cent. We do not say that a greater economy is impossible; but if it is obtained it must be by virtue of some new law in thermo-dynamics." The assumption that the economy cannot exceed 20 per cent. is merely a rough guess.

*Engineering* of October 22nd tries to show in a roundabout way that the errors due to the brake which was used in the tests of the Marchant engine "might readily amount to 60 or 70 per cent." We hope that the article which appeared in the ELECTRICAL REVIEW of last week may have set at rest the extravagant notions invented by *Engineering*.

With the appearance of a leading article in the *Engineer* of October 29th, the question has assumed a serio-comic aspect, "Concerning the Marchant engine," commences the *Engineer*, "*we know nothing* save what was to be learned *from looking at it* when shown last year in the Inventions Exhibition, and from reading circulars which have been issued concerning its performance." Then the writer, in a loose fashion, attempts to disprove Zeuner's theory, and he acknowledges that "it requires some little courage to dispute the accuracy of a proposition made by a German professor, and above all, by a man of Zeuner's reputation. Nevertheless, we do not hesitate to say that if we understand the professor aright, he is distinctly wrong; and no heretofore unknown economy is to be gained by treating the residual steam in a cylinder in the way he proposes."

The word-play which was got up "to dispute the accuracy of" Zeuner's proposition reaches its climax in such extraordinary sentences as: "If, therefore, Professor Zeuner suggests a new theory, the proposition is not sound. If, on the other hand, his proposition is sound, then it suggests nothing new. If Zeuner's proposition is unsound, then in so far as the theory of the Marchant engine is based on it, that theory is also unsound. Mr. Marchant gains nothing whatever by pumping part of his steam back into the boiler, save in so far as he raises the temperature of the feed water at the same time." And so on.

It would be presumption on our part to question the accuracy of Prof. Zeuner's theory. The only way of proving or disproving that theory is by testing it practically, and the first successful attempt, though the theory is 20 years old, is now being made by Mr. Marchant. Mr. Marchant *must* gain by pumping *steam* back into the boiler instead of water. The loss occasioned in the process of compressing the exhaust steam must be more than balanced by the *total heat* saved through condensing only one-third of the whole steam used in driving the engine, and utilising two-thirds in the form of steam for feeding the boiler.

The question is, what part does the latent heat of the steam play in the cycle of operations in the Marchant engine?

B

If, as the "writer of the article" in *Industries* assumes, the whole of the steam is condensed until it becomes water at boiling temperature, then the theoretical efficiency of a perfect engine would be 23·2 per cent. But the whole of the steam is not condensed, indeed, only one-third of it undergoes the process, and the greatest part of it is allowed to retain its heat, which is about 1,146 units as compared with 180 units of *sensible* heat at the boiling point. One pound of ordinary coal developes during combustion 12,000 units of heat, and this represents $12,000 \times 772 = 9,264,000$ foot-pounds; and $\frac{9,264,000}{33,000 \times 60} = 4{\cdot}25$ H.P. nearly, or about ·235 lb. of coal per H.P.; if the efficiency is taken between the limits of 415° and 212° or, correctly, 875° and 672° absolute temperature, the consumption of fuel would amount to $\frac{{\cdot}235}{{\cdot}232} = 1$ lb. of coal per horse-power per hour.

But this is not a true solution of the problem, because we ignore the vast amount of heat returned to the boiler, whatever the expense of doing this may be, and we see no better way of testing Zeuner's theory than by means of the existing Marchant engine, and if the result is, as we believe it is, ·8 lb. of coal per H.P. hour, we should not say, as the *Engineer* does, that there has been "made a wonderful discovery in thermo-dynamics quite undreamed of hitherto," but regard it as a perfectly natural consequence and quite in accordance with the theory of the conservation of energy.

## THE INVENTOR OF THE TELEGRAPH.

A CORRESPONDENT, who was interested by our article, recently published, upon "Galvani, his discoveries," has sent us a copy of the *Celtic Magazine* for September, wherein we find most important information respecting the first conception of the telegraph. This information is contained in an article entitled, "A Great Unknown Scot," which runs as follows:—

"The mother-spirit of the modern world is the printing-press. Without it the civilisation kindled in Italy from the old Greek and Hebrew fires would have gone out or sunk to the thinnest flame, like the hundred civilisations that before had come and gone, if the Germans, ever thoughtful and intent to save, had not made for it a lamp that cannot break and cannot be lost—the lamp of printing. This spirit had offspring, two children, one rough, boisterous, strong, and terrible as the winter winds, and men called the young giant Steam; the other, fine, subtle, delicate as the light of heaven, and its name is Electricity. But these great spirits needed education. Masters must teach them to obey the will and wish of man. Such a master was James Watt. He took in hand the young giant of steam, he waited and he watched by it, he guided and he trained it, until, from a rough and dangerous barbarian, he made it the wondrous and harmonious worker that it is. Would it not be strange if one born in the same town as Watt, about the same time, had brought out of electricity its fine qualities that enable it to abolish distance? This is what actually was done by a fellow-townsman and contemporary of James Watt. To drop all metaphor, in this case so enticing, Charles Morison, a native of Greenock, did, in the middle of last century, discover the principle of the electric telegraph, and did construct an instrument by which messages were conveyed from place to place.

"Were not the evidence, as we shall show, too plain to be mistaken, I should much incline to doubt it. Whenever anybody discovers anything, half a dozen envious spirits are ready to flood every newspaper with columns of controversial matter to the effect that he did not discover it but stole it. If you found out a way to make gold from brass, or statesmen from demagogues, you would be told that it was all set down in papers, that your grandfather most unlawfully took it from some one else's grandfather, and that you had no more right to be called a discoverer than you had to be called Emperor of China. That is human nature. But here the facts are simple, clear, and past dispute. Years before the discovery is claimed for any other man, Charles Morison knew that subtle process by which thought flashes round the earth almost with thought's own swiftness.

"In the early part of last century electricity was a toy, a pet of the study. Men no more dreamed of what it could do than they might dream that a pink morsel of baby humanity would grow into a Napoleon and cover Europe with graves. In 1736, James Watt came into the world that he was to turn upside down. It is probable that Charles Morison was born not far from the same time. Think of it. Greenock was then a cleanly, sleepy, little place. Even Glasgow was hardly bigger than a market town of to-day. Into the Greenock streets came the hardy Highlanders to traffic and—it must be confessed—to spoil the Saxon as completely as they could. Prince Charlie had not yet made his desperate struggle for his father's throne. Here in this quiet place, with its steady-going, decent people, more intent upon some venture to the Indies than upon all the politics that agitated far-off London, were born, and grew, and had their training in the world's work, two youths, each of whom had in his mind ideas the full extent and vast influence of which they themselves could as little dream as the Virgin-mother with the Holy Infant in her womb could foresee Christian Europe. Did they ever meet? Perhaps they went to school together, perhaps heard the same long sermon in the Parish Church, perhaps bright eyes long gone out, sweet lips long since ashes, gleamed and smiled with simple coquetry on both. Perhaps—but we must stop. The speculation is too romantic, too fascinating. They must have met, probably they have spoken. Whether they interchanged ideas is profitless to discuss. A great mind self-centred, self-absorbed, is not so apt to detect greatness in others as the hero-worshipping public would love to think. In 1753 Charles Morison was living in Renfrew, and had already found out his great world-changing fact. The *Scots Magazine* of that year contained the following letter, the extreme interest of which warrants us in publishing it without abbreviation:—

AN EXPEDITIOUS METHOD OF CONVEYING INTELLIGENCE BY MEANS OF ELECTRICITY.

Renfrew, *February 1st*, 1753.

To the author of the *Scots Magazine*—

Sir,—It is well known to all who are conversant with electrical experiments, that the electric power may be propagated along a small wire, from one place to another, without being sensibly abated by the length of its progress. Let, then, a set of wires, equal in number to the letters of the alphabet, be extended horizontally between two given places parallel to one another, and each of them about an inch distant from that next to it. At every twenty yards' end, let them be fixed in glass, or jeweller's cement, to some firm body, both to prevent them from touching the earth or any other non-electric, and from breaking by their own gravity. Let the electric gun barrel be placed at right angles with the extremities of the wires, and about an inch below them. Also let the wires be fixed on a solid piece of glass, at six inches from the end; and let that part of them which reaches from the glass to the machine, have sufficient spring and stiffness to recover its situation after having been brought in contact with the barrel. Close by the supporting glass, let a ball be suspended from every wire; and about a sixth or an eighth of an inch below the balls place the letters of the alphabet, marked on bits of paper, or any other substance that may be light enough to rise to the electrified ball; and at the same time let it be so contrived, that each of them may reassume its proper place when dropt. All things constructed as above, and the minute previously fixed, I begin the conversation with my distant friend in this manner. Having set the electrical machine a-going as in ordinary experiments, suppose I am to pronounce the word *Sir*; with a piece of glass or any other *electric per se*, I strike the wire, *s*, so as to bring it in contact with the barrel, then *i*, then *r*, all in the same way; and my corre-

spondent, almost in the same instant, observes these several characters rise in order to the electrified balls at his end of the wires. Thus I spell away as long as I think fit; and my correspondent, for the sake of memory, writes the characters as they rise, and may join and read them afterwards as often as he inclines. Upon a signal given, or from choice, I stop the machine, and taking up the pen in my turn, I write down whatever my friend at the other end strikes out.

If anybody should think this way tiresome, let him, instead of the balls, suspend a range of bells from the roof, equal in number to the letters of the alphabet, gradually decreasing in size from the bell A to Z; and from the horizontal wires let there be another set reaching to the several bells: one, *viz.*, from the horizontal wire, B, to the bell, B, &c. Then let him who begins the discourse bring the wires in contact with the barrel, as before; and the electrical spark, breathing on bells of different size, will inform his correspondent by the sound what wires have been touched. And thus, by some practice, they may come to understand the language of the chimes in whole words, without being put to the trouble of noting down every letter.

The same thing may be otherwise effected. Let the balls be suspended over the characters as before, but instead of bringing the ends of the horizontal wires in contact with the barrel, let a second set reach from the electrified cake, so as to be in contact with the horizontal ones; and let it be so contrived at the same time, that any of them may be removed from its corresponding horizontal by the slightest touch, and may bring itself again into contact when left at liberty. This may be done by the help of a small spring and slider, or twenty other methods, which the least ingenuity will discover. In this way, the characters will always adhere to the balls, excepting when any one of the secondaries is removed from contact with its horizontal; and then the letter at the other end of the horizontal will immediately drop from its ball. But I mention this only by way of variety.

Some may perhaps think that although the electric fire has not been observed to diminish sensibly in its progress through any length of wire that has been tried hitherto; yet as that has never exceeded some thirty or forty yards, it may be reasonably supposed that in a greater length it would be remarkably diminished, and probably would be entirely drained off in a few miles by the surrounding air. To prevent the objection, and save longer argument, lay over the wires from one end to the other with a thin coat of jeweller's cement. This may be done for a trifle of additional expense; and as it is an *electric per se*, will effectually secure any part of the fire from mixing with the atmosphere.—I am, &c.

C. M.

"Is it not wonderful? Here *is* the electric telegraph. In 1753 this Greenock man, Charles Morison, had, and used that which, even in 1886, we regard as a marvel surpassing all other marvels. We have developed and improved it, but we have done no more. The same principle is still applied in the same way. Unfortunately this man, Charles Morison, does not seem to have had that intense power which generally accompanies invention, the power of impressing ideas upon other people. That he could lucidly and completely write down his thoughts, appears by his letter, which is remarkably clear and even elegant in expression. But having written this letter, having sown, as it were, his idea in the *Scots Magazine*, he left the matter to time, chance, and his ideas' surpassing worth. No Boulton was at hand to take it up and to translate it even then into a world-encircling net-work of nerve-like wires. Twenty-one years later Lesage, in Geneva, by means of 24 wires, conveyed messages from place to place, and then Europe became too much engrossed in revolution for such a useful invention to reach early maturity.

"In 1859 Sir David Brewster disinterred this long-forgotten letter from the *Scots Magazine*, and republished it in the *North British Review*. In his remarks upon the letter he says:—'Here we have an electric telegraph upwards of a hundred years old, which at the present day would *convey intelligence expeditiously*, and we are constrained to admit that C. M. was the inventor of the electric telegraph . . . . . Everything done since is only improvement.'

"But who was C. M.? From modesty or other reasons Charles Morison had only signed his initials. Sir David Brewster was in the dark. At last light came in letters now fully given to the world for the first time. These letters, after the death of Sir David, were found among his correspondence by C. Brewster Macpherson, Esq., of Belleville House, Kingussie, and by him generously presented to the Watt Library, Greenock. Here they are, and very interesting is the story they tell:—

Port Glasgow, *October 31st*, 1859.

Sir,—Having the other evening been reading a portion of the *North British Review*, vol. 22, p. 545, regarding the invention of the electric telegraph, and having by mere chance come upon the passage which says, "It was reserved for a Scotchman, a gentleman residing in Renfrew, to suggest the idea of transmitting messages by electricity along wires passing from one place to another. The remarkable proposal was published in the *Scots Magazine* for February, 1753, in an article bearing the initials 'C. M.,' *the only name which we shall ever probably obtain* for the first inventor of the electric telegraph"—a friend of mine at present living with me here, on being shown the passage, and thinking for a minute, told me he could solve the mystery regarding the gentleman in question, with the view of sending the same to you, presuming that you were the writer of the article referred to, or connected with the publishing of the *North British Review*. He stated that in a letter which his great grandfather had written to Margaret Wingate, Craigengilte, near Denny, in the year 1752, which letter he recollects having seen, and which he believes is still in preservation, his great grandfather describes having seen a gentleman in Renfrew of the name of Charles Morrison, who was a native of Greenock, and was a bred surgeon, but it *is a question whether he ever practised his profession*, as it was known he was sometime connected with the tobacco trade in Glasgow. It is presumed he had not continued very long at the business of dealing in tobacco, but had made the study of finding out this noble science his daily theme. The people of that age were so superstitious that they believed Mr. Morrison was *crazy*, and that the *devil was acting in concert with him*, and my friend's grandfather and grandmother also thought so, and all who heard or saw him transmitting intelligence along wires by invisible means, were actually persuaded that the man was assisted by some supernatural being. From what my friend can remember of hearing, it is thought that Mr. Morrison had to leave Renfrew, in consequence of the superstitious notions of the age. Mr. Morrison did leave Renfrew, whether from this cause or not he cannot affirm, and went to Virginia, U.S., where he afterwards died.

My friend remembers perfectly well when a boy of his grandfather coming to his father's house, and telling all sorts of stories about the gentleman in Renfrew, who could transmit messages along wires, and what the general opinion was regarding him. The subject being new and interesting, caused him to listen to it with greater attention, and this is the reason he says why he recollects so well about Mr. M. at the present day.

Perhaps I am only troubling you with this long epistle for no use, as you may ere now have obtained from some one else a better history of Mr. M.'s pedigree.

My friend advised me to send the above information as an article for publication in the newspapers, but I thought it would be better to send the same first to you, and probably you might inform me if you had not already been favoured with the intelligence, and advise whether you would wish to publish the same yourself.

If you desire any further particulars regarding Mr. Morrison, I shall be happy to be at your service, and endeavour to obtain anything you may suggest.

I have the honour to be, sir,
Your most obedient faithful humble servant,

R. H. LOUDAN,
At ALEX. LADE, Esqr.'s.

Answered November 2nd, 1859. (Jotting by Sir David Brewster.) Wrote again, January 2nd, 1860. (Jotting by Sir David Brewster.)

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Port Glasgow, *January 4th*, 1860.

Sir D. Brewster, St. Andrews.

Sir,—I have to acknowledge receipt of your letter of the 2nd inst., and, in answer, beg to state that my friend, Mr. Foreman, has been endeavouring to get the letter written by his grandfather, but as yet he has not been successful. It appears the above letter, among others, are in the custody of an aunt, who lives in a small village in Perthshire. He wrote about the middle of November last to make a search for the letter, and to send it, or a copy thereof, but she wrote back saying she had not been able to find it. Mr. Foreman then stated that he would, perhaps, go and pay her a visit about the New Year, when he would make a search himself, but circumstances having prevented him from going, nothing farther has been done. He has again written to-day to his aunt to renew her search, as it is possible she, being an old woman, might not know it, although she laid her hands on it. For these reasons I have delayed writing you in answer to yours of November 2nd. So soon as a reply comes, I shall again write you, either with the letter or the statement you refer to. I would like very much the letter could be got, as it would at once settle a matter of great importance to Scotland.

I am,
Yours respectfully,
R. H. LOUDAN.

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Port Glasgow, *January 30th*, 1860.

Sir David Brewster, St. Andrews.

Sir,—In reference to my letter of the 4th inst., I now beg to send you annexed a statement by my friend, Mr. Foreman, regarding Mr. Charles Morrison. So far as he recollects he can vouch for the truth of what is therein contained. I am sorry he has not been able to get either of the letters therein referred to. His aunt being a very old and frail person, and not considering

the importance of the letters, I suppose cannot be fashed to make a search for them. Mr. F. has written her twice, and the only answer he has got was that she had not been very well, and if he wanted the letters in question, he should come himself and look for them. He says that she looks upon all the old papers and books as great relics, and would not part or lend any of them to any one upon any account whatever.

My friend has not the means, I know, else I believe he would go himself, as he appears very anxious that the matter could be solved. He says that he hopes we won't be beat, as he intends ere long of going himself, and making a search if the annexed does not suffice. Trusting that the annexed particulars may answer the object you have in view in the meantime,

I am, Sir,

Yours respectfully,

R. H. LOUDAN.

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In answer to your enquiries respecting Charles Morrison, I now beg to inform you that I recollect of having seen a letter about 30 years ago addressed by my great grandfather, Mr. Foreman, farmer, Blackdhu, near Stirling, in Perthshire, to Miss Margate Wingate, residing at Craigengelt, near Denny (to whom he was subsequently married), and which I now fully believe was dated in 1750 (instead of 1752, as I lately stated to you), referring to a gentleman in Renfrew who transmitted messages along wires short distances by means of electricity. His letter gave the gentleman's name as Charles Morrison, and described him as being a *very bashful and eccentric individual*, a native of Greenock, and bred a surgeon. I also recollect of having seen and read a letter in the handwriting of this same Charles Morrison (it being signed by him), addressed to Mr. Foreman, dated September 25th, 1752, giving a detail of his experiments in sending messages along wires by means of electricity, and stating that he had sent a description of the same to Sir Hans Sloan in London, by whom he was encouraged to perfect his experiments, and that he intended giving him a more detailed account in the following year, 1753, when he hoped also to be able to publish a minute narration thereof in the *Scots Magazine*. His letter also stated Sir Hans Sloan at that time was an aged man, and very frail, and that it would probably be about the month of May, 1753, before he could comply with the requirements of Sir Hans; but Mr. Morrison appears to have been able to comply sooner than he expected, as the letter is dated February in the *Scots Magazine*. It also stated that as he was likely to be ridiculed by many of his own acquaintances, and as it was a thing the great world cared little about, he would only publish his initials. What causes me to recollect the date, September 25th, of the above letter at this day is, that I was born on that day and month.

The letters above referred to I believe are still in preservation, and if I had an opportunity I would go myself and make a search for them. They are in the possession of an aunt of mine who resides near Stirling. If they have been destroyed it must have been within the last few years, as I know she had them lying in a garret among a great number of other old papers and books.

I forgot to say that there are descendants of Margt. Wingate above referred to, of that name, who are shawl manufacturers in Glasgow, and I have no doubt if they were communicated with they might in some way or other verify the truth of the above statements.

D. W. FORMAN.

"And this is all we know of the great man who first found out the great idea of electric thought communication. He was 'very bashful and eccentric,' crazy, devil-aided, a surgeon who never practised surgery. We can well believe the last. Who would trust the cure of his body to a man who professed to be able to do such dreadful things? He was either a rank imposter or—— imagination shuddered to think what. One may readily imagine the trembling mother drawing her brood around her, and looking upon the unhappy person with wrath and suspicion, who ventured to suggest that the demon-doctor should be sent for to look at her poor sick baby. Was it not a condition of the fiend that once a year a child should be offered at the devil's sacrament? Poor 'bashful and eccentric' Morison. Readers smile sadly to think of him with his idea, shyly shuffling along, while the parish minister perchance stopped him to give him solemn warning; while the wise, common-sense spirits, too well taught to believe either in the old or the new, tittered as he passed, and made jests which, witty or no, received tremendous applause. The poet of the place made verses about him, no doubt, and when the minister preached about the Witch of Endor every eye in the church was turned upon him. At last, tired of it all, he went away; he emigrated to the United States. Search is being made in Virginia to see if he has left any traces there. We doubt if the searchers will succeed. A man of his nature, if he makes an effort and fails, rarely tries again. Probably his invention made his life in Scotland so intolerable to him that he would ever afterwards seek to bury himself and it from human investigation. Scotland, in 1753, to a 'very bashful and eecentric' man, with a great idea, must have seemed a very considerable distance from heaven. At any rate, that is all *we* know about him. These few stray lights fall upon what was certainly a great and strange, and was probably a lonely and lovely nature. We would fain know more. Scotsmen throughout the world must look with reverence upon this brother Scot, whose name should be placed high on the long roll of their illustrious dead. It may be that written or oral tradition of him lingers hidden, dusty and dim in manuscript or memory. If such there be, and these lines meet the eye of anyone in whose mind is the slightest hint of these hid treasures, we earnestly entreat him to search diligently until he find them, and to communicate with Allan Park Paton, Esq., the learned and well-known librarian of the Greenock Library. This gentleman—the editor of that Hamnet Shakespeare, so much regarded by actors and students, and so well appreciated by the general public—has set himself with characteristic zeal to rescue Morison's name from the waters of oblivion that seem well nigh to have overcome it; for in the above article of Sir David Brewster, and a passing allusion of Mr. Tyndall, is summed up all the honour that has been paid to his memory. In a glass frame, hung upon the walls of the noble Greenock Library, Mr. Paton has, very lately, placed all that has been written about this great unknown. Surely the people of Greenock will come to his help. What a noble boast it would be of any town to be able to take strangers and to point out to them two great monuments, placed side by side, saying, 'By the thoughts of these two men has the whole modern world been more changed than in all the ten thousand years of old history. These two sons of Greenock, born on this shore, bred beside these hills, nurtured in our schools, mastered the two giant powers of steam and electricity, and tamed them to obey man more perfectly than ever plantation slave obeyed his master.' Greenock people should insist that henceforth their town be known as the birthplace of James Watt and Charles Morison.

"Greenock." "W. J. DOUGLAS.

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## TELEPHONE CIRCUIT FOR SPEAKING CONDENSERS.

MR. WILLIAM MARSHALL, of New York, has devised a novel arrangement of considerable interest in the employment of the speaking condenser as a receiver. While the condenser can be made to speak, the *Electrical World* states, Mr. Marshall asserts that unless the line wire connecting the stations is made continuous, as by shunting the speaking condenser, or by the new method described below, the articulation and volume are not perfect, speech being scarcely audible when more than one speaking condenser is inserted in the line.

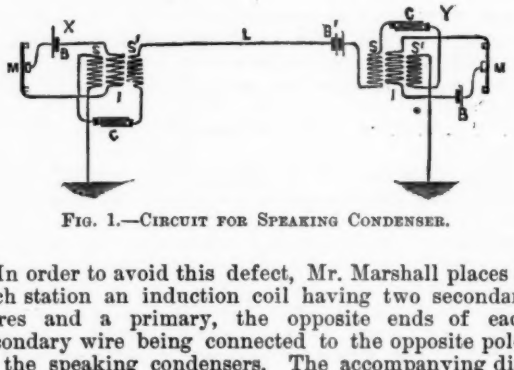



FIG. 1.—CIRCUIT FOR SPEAKING CONDENSER.

In order to avoid this defect, Mr. Marshall places at each station an induction coil having two secondary wires and a primary, the opposite ends of each secondary wire being connected to the opposite poles of the speaking condensers. The accompanying diagram, fig. 1, shows the complete arrangement.

As will be seen, the poles of the speaking condensers, C, C, are connected with the opposite ends of the secondary wires, S, S′, of the induction coil, I, the primary of which includes the battery, B, and microphone transmitter, M. The line wire has in circuit the battery, B′, which polarises the speaking condensers, C, C. When the microphone, M, at station Y, is spoken to, the current induced into the line reaches the induction wire, S′, at station X, changing the polarisation of the plates of the condenser, C, with which it is in contact, directly, and the opposite plates of the same condenser inductively, with the same direction of current through the other secondary wire, S. With this arrangement of circuits, the opposite plates of the condenser vibrate in unison and hence with greater force.

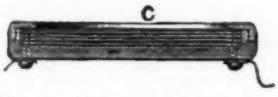



FIG. 2.—SPEAKING CONDENSER.

It has also been observed by Mr. Marshall that the condensers speak much louder when the metallic plates are, in part, not in contact with the insulator. He therefore constructs his condenser receiver as shown in fig. 2, in which the middle of the plates is made loose by pressing the circumferences together, the plates and insulators bulging sufficiently in the centre to separate themselves, and thus to allow free vibration.

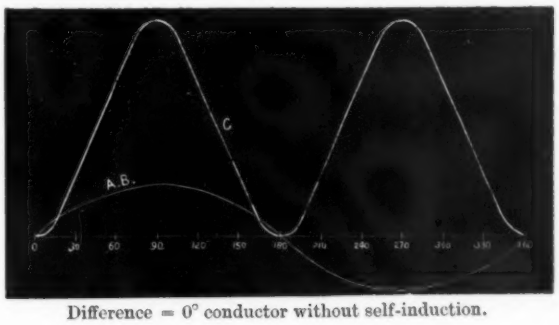
## THE MEASUREMENT OF THE POWER ABSORBED BY ALTERNATING CURRENT APPARATUS.

WHEN we wish to determine the power absorbed by any electrical apparatus whatever, writes M. Hospitalier in *L'Electricien*, the simplest method is to measure the difference of potential in *volts* at the terminals of the apparatus, and the intensity in *ampères* of the current passing through it: the product of these two quantities gives the electrical power absorbed in *watts*.

This method, which is exact when we are employing currents that are continuous or practically continuous, such as machines called continuous current machines, in which the variations of intensity may be disregarded, is subject to certain reservations when periodical currents are used, especially in the case of alternating currents, and when the apparatus expending the electrical energy is the seat of more or less complex reactions from induction. In this case, the product of the indications of a Siemens electrodynamometer by those of a Cardew voltmeter does not *a priori* give any reliable information as to the electrical power really expended, which may vary between a maximum limited exactly by the product of the indications of the two measuring apparatus, and a minimum, the theoretical limit of which is zero.

The following diagrams are intended to show this clearly:—

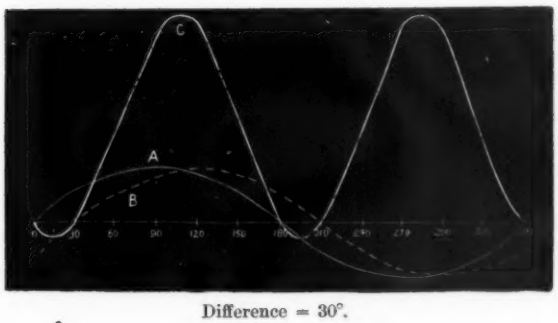
Let us first consider a periodical electromotive force, sinusoidal in form, so as to simplify the reasoning established between the terminals of a conductor, the co-efficient of self-induction of which is 0, or may be disregarded. The intensity of current will be given each moment by the ratio of the electromotive force to the resistance of the circuit. By choosing the scales and the resistance of the circuit to suit our purpose, the numerical values of the intensity, I, and the electromotive force, E, will be equal at each moment. If we take a complete period, and express on a diagram the time in abscissæ and the values of I and E in ordinates, we shall get two sinusoidal curves blended in the fine line of fig. 1. The electrical power expended each moment will be equal to the product, E I, *i.e.*, to the square of E or of I, and represented by the thick curve




Difference = 0° conductor without self-induction.

FIG. 1.

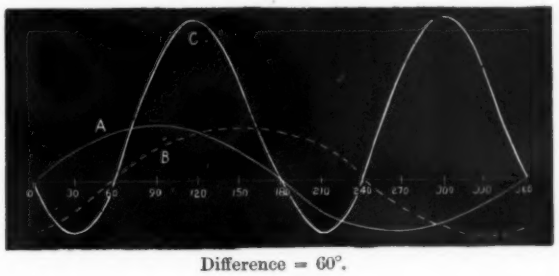
of fig. 1. The work absorbed during a complete period will be represented by the *positive surface* comprised between the axis of $x$ and the two thick curves (fig. 1).




Difference = 30°.

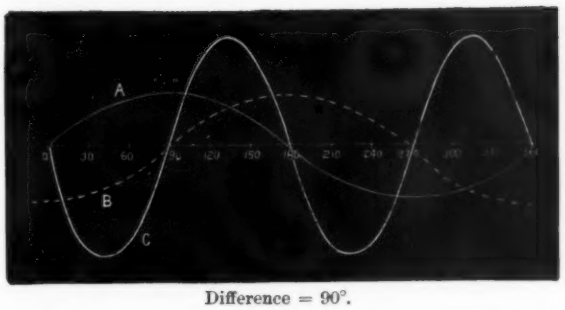
FIG. 2.

The *mean* power corresponding will be the ratio of this surface to the duration, $t$, of the period. In this particular case, which is very sensibly realised when




Difference = 60°.

FIG. 3.




Difference = 90°.

FIG. 4.

the periodical current feeds inert resistances or incandescence lamps, there is no difference between the value of the mean electrical power actually expended and that which results from the product of the indica-

tions of the voltmeter and the electro-dynamometer. Let us now substitute for the ordinary resistance an apparatus presenting self-induction and mutual induction, such as a transformer.

Theory shows that in this case there arises a *difference of phase* between the intensity of current, I, and the electromotive force, E, and that this difference may vary from 0° when the coefficient of self-induction of the apparatus is 0 to a maximum of 90°, a theoretical limit which is never attained in practice. The determination of the exact value of this difference is very difficult, for it depends on the duration of the period, on the co-efficients of mutual induction, and of self-induction in the inductive and induced circuits of the apparatus to be measured, on the presence or absence of an iron core, of the greater or less magnetic saturation at the moment of the maximum current, &c. Experiment alone can make us acquainted with the value of this difference for every condition of working the circuit; but we may ascertain its influence by constructing curves corresponding to some of the special values that it may have. This is what has been done in figs. 2, 3 and 4, which correspond respectively to 30, 60, and 90 degrees, supposing, be it understood, that the conditions of working the machine have been modified so as to preserve the same mean numerical indications for the intensity of the current, I, and the difference of potential, E, at the terminals of the apparatus to be measured.

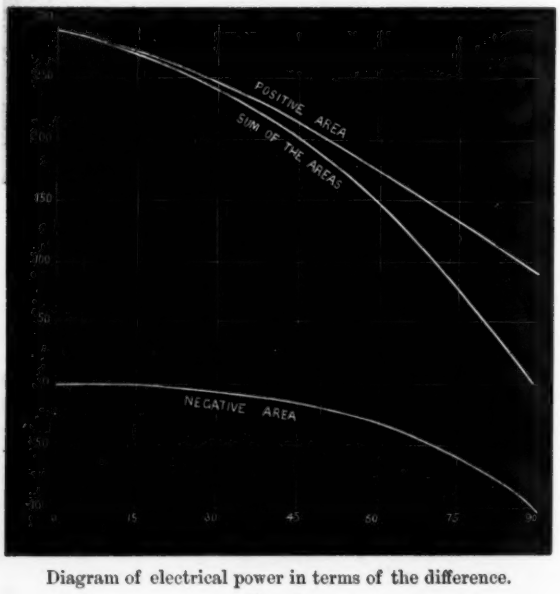



Diagram of electrical power in terms of the difference.

FIG. 5.

In the three cases under consideration we see that the curve representing the power has two negative portions, which involve not an expenditure but a restitution of energy stored up a moment before in the reactions from induction.*

The positive area representing the work expended diminishes, whilst the negative area representing the work restored increases. This action, hardly appreciable with a difference of 30 degrees becomes pronounced with one of 60 degrees. At the theoretical limit with a difference of 90 degrees (fig. 4) the two areas, positive and negative, are exactly equal, and the total work expended during the period is equal to zero, although the indications of the voltmeter and the electrodynamometer remain constant.

Fig. 5 sums up these results. The values of the difference are carried out in abscissæ, and the ordinates show the respective values of the positive work, the negative work and the algebraic sum of the two for a complete period.

This figure shows the great importance of this difference from the point of view of the difference between the electrical power really expended and that obtained from the product of the indications of the instruments of measurement.

For a difference of only 30 degrees the difference between the work really expended during a period and that deduced from the indications of the measuring apparatus would exceed 15 per cent.

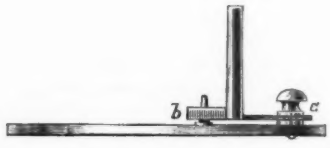
Thus there remains much to be said about the power and the rendering of transformers, and, in general, about all apparatus supplied by periodical currents.

* The effects thus produced may be compared, by analogy, to those of a fly-wheel mounted on a machine, the speed of which is irregular. The successive storages and restitutions of energy weaken the variations without involving any loss.

## GILBERT'S IMPROVED SINGLE NEEDLE INSTRUMENT SOUNDERS.

THESE sounders, the invention of Mr. A. E. Gilbert, telegraph superintendent of the Highland Railway Company, are designed for fitting to the ordinary single needle dials. Such sounders are not new in general principle, but the particular form devised by Mr. Gilbert is novel and seems well adapted for the purpose intended. Fig. 1 shows the tin blank from which each of the sounders is formed. Fig. 2 shows the same bent into shape. Fig. 3 is an elevation of the dial plate of

FIG. 3.



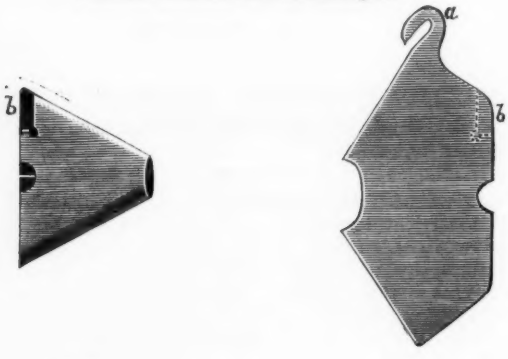




FIG. 2 FIG. 1.

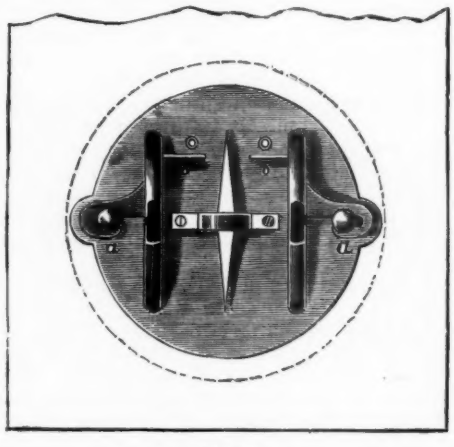



FIG. 4.

the dial showing one of the sounders fixed in position, being held by the dial knobs, and prevented from touching the dial plate by washers placed under the ears, *a*. The lugs, *b*, form the pieces against which the needle strikes. Fig. 4 represents a front view of the dial showing the sounders in position. If preferred the sounders may be reversed so that the lower half of the needle strikes against the lugs, *b*, in which case the sound obtained will, in cases where the lower part of the needle is heavier than the upper, be louder. The form of sounder described is the result of numerous experiments.

## THE SEVERN TUNNEL.

THIS tunnel has been opened since 1st of September for goods traffic, and will shortly be opened for the conveyance of passengers, which will add to the convenience of the travelling public, especially between the West of England and South Wales.

The Great Western Railway Company has adopted Mr. C. E. Spagnoletti's new system of electric locking for working the traffic through the tunnel.

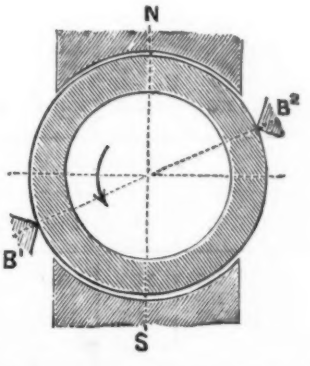
The instrument consists of a case with two circular holes in it, one above the other; the upper hole shows indications for trains "departing," the lower hole shows indications for trains "approaching." Below the holes is a plunger, and on each side is a key—one red, one white. The normal condition of the instrument shows in the upper hole "lock on" (a red signal), and in the lower hole "train arrived" (a green signal).

When a signalman is asked "Is line clear" by the ordinary bell signal given on the instrument describing the train, should the line be clear for the train to come on, he will press the plunger, which will bring up the "white" disc in the lower hole of his instrument, showing "line clear," indicating to him that he has given "line clear" to the station in the rear for a train to come on. The effect of this at the station in the rear is, that in the upper hole of the instrument is shown the white disc, "line clear," and the lever of the starting signal is unlocked; the signal is pulled down to let the train start, and on putting the lever back again to protect the train it is again locked. The man at the station in advance is unable to unlock this lever again until the train has arrived at his station and passed over the contact treadle which resets the instrument and renders it in a condition for sending another signal. The lock on the lever renders it impossible for a signalman to move it until it has been unlocked by the station in advance.

The general arrangement of the locking apparatus is, we believe, similar to that described in the No. of the REVIEW for February 1st, 1881.

## ELECTROMOTORS AND GENERATORS.

THAT the views expressed by different writers regarding electromotors vary widely, says W. B. Esson, in *Industries*, is doubtless due to the fact that comparatively few experiments have been made with this class of apparatus. The belief that the reaction taking place in a motor is different from that of a generator, is very prevalent, and it is frequently taken for granted that motors have a theory of their own, the rules which should guide constructors in dynamo designing being quite inapplicable in their case. The object most frequently kept in view in dynamo designing, is to obtain the highest efficiency, weight being a secondary consideration; in motor designing, on the other hand, the object is frequently to obtain the greatest power for a given weight, efficiency becoming a matter merely of secondary importance. If motors, in their construction, have differed from generators, it is because different objects of attainment have been kept in view; but given the same object in each case, whether it is maximum efficiency, or maximum output, then both motor and generator must be constructed on similar lines, and in accordance with similar rules. It has been urged again and again, that while in a generator the effect of the current flowing round the armature is to create a resultant field weaker than that due to the magnets alone, in a motor the effect is to produce a resultant field stronger than that due to the magnets. By some unaccountable confusion of ideas, however, one fact has escaped notice, and that is that the condition for motors which would make this possible, viz., a forward lead to the brushes, is one which is never met with in practice, and one which, if adopted, would very soon lead to the destruction of the collectors. The theory that, in motors, the resultant field due to the currents in magnets and armature differs from that in generators, has lately been emphasised by Mr. Reckenzaun, in his papers on Electric Locomotion, published in the ELECTRICAL REVIEW.* It is unfortunate for the theory that no facts are adduced which would tend to give it support. That the resultant field in a dynamo is the same, whether driven as motor or generator, may be clearly perceived from the following considerations. In the annexed sketch let N and S represent the north




and south poles of a series dynamo, $B_1$ and $B_2$ indicating the position of the brushes. If the machine be driven as a generator, rotating with the arrow, the current will flow through the armature in a direction such that $B_1$ will become a south pole and $B_2$ a north pole. Let us now run the dynamo as a motor, sending through it in the same direction, a current of the former magnitude. Obviously the armature and magnet poles will occupy the same relative positions, and have the same intensity as before. Everything remains unchanged but the direction of rotation of the armature, and in the absence of any disturbance caused by an irregular form, or improper sub-division of armature core, the distribution and number of field lines will be exactly the same as when the machine is worked as a generator. In the above case the brushes have, when working as a motor, a displacement backwards, equal to that which in a generator they have forwards, this being their correct position if sparking is to be avoided.

From the above reasoning, it is evident that the same E.M.F. is generated by the machine, whether it is driven as a motor or generator. That the distribution of field lines is similar in each case, might have been inferred simply by observing the conditions which determine the proper position for the brushes. Experience shows that, to avoid sparking, the brushes have to occupy a position on the collector which is independent of the speed of rotation, but which depends only on the relative directions and magnitude of the currents in the armature and magnets. This means that the field distribution remains unaltered by velocity. Again, with machines in which the armatures are properly laminated, the line connecting the E.M.F. and speed is perfectly straight. This means that the field strength remains unaltered by velocity. Finally, if both these statements are true, the direction of

* ELECTRICAL REVIEW, Vol. XVIII., page 278.

rotation can be reversed, without in any way affecting the distribution or strength of field, provided there still flow currents of the same magnitude.

By the courtesy of Messrs. Paterson and Cooper, I have been enabled to make a few experiments on the Phœnix machine, for the purpose of verifying the above conclusions, with the results shown in tables I. and II. The plan adopted was this. The particular machine to be tested was run first as a motor with any E.M.F. at hand, and braked with any convenient load, the speed, current, and E.M.F. being noted. When sufficient readings were obtained in this way, it was run as a generator at the speed and current formerly observed, the E.M.F. being noted. In the series machine, if C is the current, and R the resistance, $V_1$ being the observed difference of potential at the terminals of the generator, and $V_2$ that at the motor, then $V_1 + CR = V_2 - CR$. Table I. shows the results obtained when the armature has protruding iron teeth, and table II. the results when the armature core is smooth on the exterior.

TABLE I.

| Revs. per min. | $V_1$ | $V_2$ | C | $V_1 + CR$ | $V_2 - CR$ | Diff. |
|---|---|---|---|---|---|---|
| 820 | 47 | 80 | 4·5 | 63·00 | 64·00 | 1·00 |
| 940 | 58 | 96 | 5·0 | 75·30 | 78·70 | 3·40 |
| 1295 | 87 | 130 | 6·0 | 107·70 | 109·30 | 1·60 |
| 1430 | 104 | 152 | 6·75 | 127·37 | 128·63 | 1·26 |
| 1520 | 106 | 158 | 6·75 | 131·13 | 132·87 | 1·74 |

TABLE II.

| Revs. per min. | $V_1$ | $V_2$ | C | $V_1 + CR$ | $V_2 - CR$ | Diff. |
|---|---|---|---|---|---|---|
| 820 | 58 | 136 | 12·0 | 98·0 | 96·0 | − 2·0 |
| 1700 | 134 | 168 | 5·0 | 150·6 | 151·3 | 0·7 |
| 1880 | 136 | 168 | 4·5 | 151·0 | 153·0 | 2·0 |

It will be seen that the agreement, especially in Table I., is rather remarkable, considering the nature of the experiments; at the same time it will be noticed that $V_2 - CR$ is generally greater than $V_1 + CR$. On investigation, it turns out that, although there is created in motor and generator the same E.M.F., $V_2 - CR$ should always be greater than $V_1 + CR$, on account of the self induction of the armature. The reason is this: In any dynamo, whether running as motor or generator, there is evolved, due to the self induction of the armature, a counter E.M.F. which opposes the flow of the current. Call it $\epsilon$. In a generator this must be balanced by a corresponding E.M.F., and we have, therefore, the current flowing as the result of an E.M.F. $= E - \epsilon$, where E is the total E.M.F. generated by the armature, due to its rotation in the magnetic field. In a motor, due to the armature's rotation, the current is opposed by an E.M.F. $= E$, and due to self induction by a further E.M.F. $= \epsilon$, the total E.M.F. opposing the current being, therefore, equal to $E + \epsilon$. If now we add in a generator $CR$ to $V_1$ we get really $E - \epsilon$, whereas if we subtract $CR$ from $V_2$ in a motor, we get $E + \epsilon$. The difference is $2\epsilon$, and with greater care in the experiments it might be possible to determine from them the coefficient of self induction for the armature. This article would be incomplete without some reference to the cause of these experiments being undertaken, which is to be found in Mr. Kapp's recent book on the Electric Transmission of Energy. In his book, Mr. Kapp gives three curves, connecting the current with the E.M.F., generated by a Bürgin series dynamo, the top curve when running as a motor, the lower when as a dynamo, and the middle one when the current measured by the abscissæ flowed in the field-magnets only. So extraordinary did these results appear and so clear, on the other hand, were reasons for their not appearing, that the experiments already described were undertaken, and followed by an experiment on the Bürgin machine, by which Mr. Kapp's results were, in a measure, verified. The fresh results obtained are given in table III. There is no agreement here between

TABLE III.

Bürgin Machine No. 333 B.

| Revs. per min. | $V_1$ | $V_2$ | C | $V_1 + CR$ | $V_2 - CR$ | Diff. |
|---|---|---|---|---|---|---|
| 500 | 16 | 116 | 14·0 | 64·67 | 67·40 | 2·73 |
| 640 | 36 | 130 | 12·5 | 79·46 | 86·54 | 7·08 |
| 720 | 60 | 98 | 4·25 | 74·11 | 83·89 | 9·78 |
| 780 | 59 | 138 | 10·0 | 93·77 | 103·23 | 9·46 |
| 830 | 66 | 142 | 9·0 | 97·30 | 110·70 | 13·4 |
| 840 | 72 | 118 | 4·5 | 87·00 | 103·00 | 16·0 |
| 860 | 70 | 144 | 8·75 | 100·40 | 113·60 | 13·2 |
| 1100 | 104 | 152 | 4·75 | 119·77 | 136·23 | 16·46 |
| 1180 | 114 | 164 | 5·0 | 130·60 | 147·40 | 17·20 |

$V_1 + CR$ and $V_2 - CR$, and on reducing all the readings to one common speed, it will be found that the difference is greater the smaller the current. This is a result quite opposite to that which would be obtained were it due to self induction. It is thought, however, that the result may be due to eddy currents in the hexagonal ring cores of the armature, these being formed of iron wires, but forced over 8-inch metal spiders, with such pressure as to bring the wires into absolute contact at the corners. Pending further experiments, an explanation will not be attempted at present; but it is certain that the peculiar construction of the armature is accountable in this instance for results which are quite different from those given by armatures of regular form and properly subdivided.

## ON THE INTENSITY OF THE MAGNETIC FIELD IN DYNAMO-ELECTRIC MACHINES.

THE most important element of a dynamo-electric machine, writes M. Marcel Deprez in *Comptes Rendus*, is the magnetic field, and we may even say "as is the magnetic field so is the machine." This is true, contrary to the opinion of certain electricians, as well when the machine serves as recipient as when it is employed as a generator. The magnetic field itself comprises two elements, volume and intensity, which in different degrees constitute its useful qualities. It is evident, in fact, that a field very extensive, but of very little intensity, like that of the globe, can render no useful service, and that a field extremely intense, but very small, like that obtained on bringing the opposite poles of a powerful magnet almost into contact, can be employed usefully only under very restricted circumstances, since the conductors destined to come within the action of this field can themselves have only a very small volume.

If in a dynamo machine we have given all the dimensions of the inductors, as well as the intensity of the current circulating in their coils, leaving variable the extent of the polar enlargements as well as the distance separating them from the iron core of the induced ring, the volume of the annular magnetic field comprised within these two parts, and in which the induced wire moves, may be easily calculated with all accuracy, but it is not the same with the intensity of the field, which varies according to laws impossible to calculate theoretically. We can merely say that it is natural to think that it decreases if we increase the extent of the polar expansions or the distance which separates them from the iron core of the induced ring.

To elucidate this question, I have undertaken a long series of experiments under very varying conditions. I have operated upon electro-magnets of three different sizes, whose iron cores had the respective diameters of 200, 90, and 60 millimetres, and in each of them I have measured the intensity of the field comprised: (1) between the opposite poles of two identical electro-magnets, both animated by the current, and (2) between the

poles of the electro-magnet and an iron armature submitted to its influence.

The intensity of the field was inferred from the measurement of the effort exerted perpendicularly to the lines of force upon a movable conductor traversed by a continuous current. I caused to vary, for each of the types of electro-magnets submitted to experiment, the dimension of the field taken in the direction of the lines of force, that is to say, the distance of the magnetic surfaces between which it is included; the dimension of the field taken perpendicularly to the lines of force, that is to say, the magnitude of the polar expansions, and lastly, the intensity of the current traversing the magnetising coils.

It is impossible to reproduce here all the figures belonging to these different series of researches. I must be content to put on record the fundamental facts which these experiments have established beyond doubt.

*Influence of the Mutual Distance of the Magnetic Pieces.*

Contrary to what certain electricians have affirmed, *the intensity of the field decreases much less rapidly than the distance of the magnetic pieces increases.* I cite, for instance, the experiments made upon two electro-magnets, with two branches having iron cores of 200 millimetres in diameter, in which the intensity of the field included between the two opposite poles still preserves the half of its primitive value when the mutual distance of the two poles is increased from 7·5 millimetres to 75 millimetres, that is ten-fold.

When the field is comprised between a magnetic pole and an iron armature, magnetised by its influence, the decrease of the intensity corresponding to the increase of the distance is more rapid; but it is still very far from what was once supposed, since, instead of being proportional to the square of the distance of the magnetic pieces in question, as it has been affirmed by certain persons led by a crude analogy, it is superior even to the inverse of the square root of the distance. To render this more clear, when the distance increases from 1 to 4 the intensity of the field falls from 1 to 0·6.

In all cases, the larger the cores of the electro-magnets the more considerable is the current which excites them; the thicker the armatures upon which they act, the less is the influence of the distance from the armature to the poles of the electro-magnet. *Hence it follows that on bringing the armatures of the inducing poles very close, we increase the intensity of the field very little, whilst we reduce the place available for the induced wire almost to zero.*

If in a dynamo machine we vary the annular space comprised between the polar expansions and the outer surface of the iron core of the ring as well as the quantity of induced wire coiled upon the latter so as to fill the annular space as completely as possible without interfering with the free action of the machine, it is certain that the efficacy of the machine will vary with the dimension of the annular space; it will be null when this dimension is very small, because the insulating materials which surround the iron ring, as well as the material play which must exist between it and the fixed polar pieces, will absorb all the available space and leave no place where the induced wire may be introduced. It will be, if not null, at least very feeble, if we give an excessive dimension to the annular space. There exists, therefore, a dimension of this annular space corresponding to the greatest possible efficacy of the machine. But before searching for the most favourable dimension we must define this efficiency. If we determine all the dimensions of the machine (except the annular space) its speed of rotation and the electromotive force which it should produce, I will say that its efficiency is greatest when the internal resistance of the ring is at a minimum.

If we call $x$ the dimension of the annular space taken in the direction of the radius of the ring; $a$, the minimum value of the space allowed for the insulating matters which cover the iron core, for the play-room indispensable to the free working of the parts, and, in a word, for all matter *other than the copper* conductor of the current coiled around the induced ring, such space being likewise taken in the direction of the radius, and H the intensity of the field, I demonstrate easily that the internal resistance of the machine is a minimum when the function, $H^2 (x - a)$ is a maximum.

The experiments referred to above show that this maximum occurs for values of $x$ much greater than is commonly supposed. These results, moreover, merely confirm those which I obtained about eighteen months ago with Gramme machines, in which I diminished the annular space more and more. The intensity of the magnetic field increased beyond doubt, but the machine became very decidedly worse as the annular space became smaller.

In machines of high tension such as those which I had constructed for the experiments at Creil, the value of the constant, $a$, is much greater than in machines of a low tension, because they require a far more perfect insulation.

Hence it results that the function, $H^2 (x - a)$, reaches its maximum only for values of $x$ very much greater than if $a$ were small. This is the reason why I have been obliged to give the annular space so great a value in the Creil machines. This will readily appear if we know that the distance from the outer part of the induced wire to the polar pieces reaches in places 0·010 metre, and that the thickness of the insulating layer interposed between the iron core and the first layer of the induced wire was 0·0075 metre, this then made a space of 0·0175 metre entirely lost for the useful effect of the machine, so that if I had only given to the annular interval 0·020 metre, there would remain for the induced wire merely 0·0025 metre, that is to say, room enough to lodge a single layer of wire, the machine would not have yielded the eighth part of the electromotive force required.

*Influence of the Dimensions Perpendicular to the Lines of Force.*

I have made few experiments in this respect, but I have been able to ascertain that unless the polar pieces are very thick in the direction of the lines of force the intensity of the field is approximately in the inverse ratio of the developed surface of the polar expansions taken perpendicularly to the lines of force.

With electro-magnets, the core of which was 200 millimetres in diameter, the magnetic field comprised between the poles has reached the value of 15,400 C.G.S. units when the polar pieces of a square form measured 200 millimetres per side and were 3 millimetres apart; it was still 11,400 units when the distance was 20 millimetres. The electric work expended collectively in the helices of the two electro-magnets amounted to 9 horse-power.

I proved, some years ago, that electro-magnets with a thick core were much superior to a group of small electro-magnets having collectively an equal weight as regards the absolute intensity of the field which they produce and of its volume, as well as of the quantity of energy which must be expended in their coils to produce such a field. I was the first to construct very thick and short electro-magnets (experiments in the depôts of the Northern of France Railway, in February, 1883) instead of employing electro-magnets of small diameter, long and numerous as was done in the Edison machine which figured at the Exhibition of 1881. My example has been followed with full success, and the magnetic field of the Edison machines since constructed has been considerably improved simply by decreasing the length of the electro-magnets and thickening the core.

I think that if we constructed electro-magnets with a core of 300 millimetres in diameter in place of 200 like those just mentioned it would be possible, with a field included in a parallelopiped of 300 millimetres wide and 5 millimetres in height, to obtain an intensity of 20,000 units by placing opposite to each other two electro-magnets magnetised in opposite directions and excited by the same current.

## EXPERIMENTS ON THE TRANSMISSION OF POWER.

By M. HIPPOLYTE FONTAINE.

SINCE 1873, the date of our first experiments on the transmission of power by electricity, we have carried out a great number of industrial applications in workshops, arsenals and mines.

These installations generally comprise a Gramme machine as generator and a recipient. In certain cases we have employed several recipients of unequal speeds and different powers, mutually independent. The maximum of useful power transmitted has been 20 horse-power, and the greatest resistance of the line 8 ohms.

The total weight of the generating and recipient machines corresponds to about 200 kilos. per horse-power transmitted, and the cost of the material is about 3 francs per kilo.

The "Electric Company," assignees of the Gramme patents, have kindly consented to place their laboratory, their plant and their staff, at our disposal for these experiments.

The Gramme machines employed have been constructed by the inventor on a new plan, called the *superior type*, and they are as identical among themselves as an industrial construction admits of.

The generator of electricity consists of four machines connected in tension, and impelled directly by two large pulleys by means of two friction rollers. The two pulleys are fixed upon one and the same shaft receiving the movement of the fly-wheel of the moving engine by means of a driving band. The Gramme machines are placed one on each side of the pulleys so as to equilibrate the lateral pressure upon the bearings.

The recipient is formed of three Gramme machines, likewise arranged in series and connected together on Raffard's system. A Prony brake is placed between two of the machines of this group.

The total electric installation is thus composed of seven Gramme machines; four in series at the point of departure to produce the current, and three in series at the point of arrival to furnish the utilisable power.

The armature of these machines is an ordinary Gramme ring of 0·30 metre in diameter and 0·35 metre in length, composed of 200 elementary bobbins coiled on a circle of iron wire; its resistance between the brushes is 4·75 ohms. The inducer is a horse-shoe electro-magnet formed of a single block of cast metal, and comprises the stand of the machine, the cores receiving the wires, the polar pieces and one of the plummer blocks. The second plummer block is the only piece introduced into this construction, which thus presents itself in the best possible conditions of stability and simplicity.

The resistance of the inducer is 6·65 ohms, and that of the entire machine 11·40 ohms.

Preliminary trials showed:—1, that we must not go beyond 11 ampères if we wish the machine to act for 24 consecutive hours without abnormal heating; 2, that the electromotive force of 1,600 volts was a practical maximum beyond which the electric yield decreases. This electromotive force corresponds to a speed of about 1,400 turns per minute.

The electric yield is 79 per cent. at 600 turns and 81 per cent. at 1,400 turns.

Having set the seven machines in motion and interposed between the two groups a resistance of 100 ohms, we found at the very outset that it was practicable with this installation to transmit 50 horse-power under really practical conditions.

To find the industrial yield we took the diagrams at the cylinder of the steam engine, driving alternately the Gramme generating machines and a Prony brake.

In this manner we have been able to estimate with a sufficient approximation the power expended during each of our experiments.

The following are the results obtained October 19th, 1886:—

| | |
|---|---|
| Speed of the steam engine ... | 56 turns. |
| Speed of the Gramme generators | 1,298 „ |
| Difference of potential at the extremities:— | |
| 1st machine ... ... ... | 1,490 volts. |
| 2nd „ ... ... ... | 1,505 „ |
| 3rd „ ... ... ... | 1,493 „ |
| 4th „ ... ... ... | 1,508 „ |
| Difference of potential at origin of conducting line ... ... | 5,896 „ |
| Intensity of current ... ... | 9·34 ampères. |
| Resistance of line ... ... | 100 ohms. |
| Work at piston of engine ... | 112·8 H.P. |
| Yield of engine ... ... ... | 85 per cent. |
| Work received by the generators and the mechanical transmission | 95·88 H.P. |
| Speed of recipients ... ... | 1,120 turns. |
| Work recovered at brake ... | 49·98 H.P. |
| Industrial yield ... ... ... | 52 per cent. |

In an experiment made on October 20th, in presence of Prof. Potier, of the Polytechnic School, we obtained at the brake 50·3 horse-power, with a resistance of 99·9 ohms between the machines and the same diagrams at the indicator as on the previous day.

These experiments prove that it is possible to transmit an effective force of 50 horse-power through a resistance of 100 ohms with an industrial yield exceeding 50 per cent., by employing electric machines having at their extremities a difference of potential of only 1,500 volts.

The seven Gramme machines employed weighed only 8,400 kilos.

The weight of metal, including the stands, is therefore 167 kilos. per horse-power transmitted through a resistance of 100 ohms.—*Comptes Rendus.*

## REVIEW.

*Note Book and Price List with Useful Formulæ.* R. E. CROMPTON & Co., Mansion House Buildings, London, E.C.

Since this note book was first issued it has been thoroughly revised and also enlarged. Although nominally a price list of the firm of R. E. Crompton and Co., it is actually more of a universal character, and will prove useful when both estimates and specifications have to be drawn up. The additions that have been made in the present edition appear to have been judiciously selected and increase the utility of the work.

## BERLIN JOINT STOCK ELECTRIC LIGHT COMPANY.

THIS company's conditions for supplying an electric current, whether for lighting or for other purposes, says *Zeitschrift für Elektrotechnik*, are as follows:—

1. The company undertakes at its own expense the execution of the main conductors leading from the central establishment and passing to the buildings concerned, whether in streets, courts, or gardens.

2. The company carries out the connection with the main conductors, and the arrangements for conductors and illumination in the interior of the premises. This is done on the basis of an estimate previously agreed on, in accordance with the requirements of subscriber and at his expense. The plan for the illuminating arrangements is furnished gratis, if carried into execution, otherwise the company charges 5 per cent. of the estimated cost.

Changes and repairs are to be executed only by the company or its authorised representatives, and the company is responsible for the work. Connections which have been cut off can be re-connected only by the servants of the company.

Until the cost of the installation has been paid in full the latter remains the property of the company, and in case of non-payment it may be again removed. In this case, however, the subscriber remains responsible to the company for the expense of fitting up and removal, and for the depreciation of the materials.

The carrying out of the installation by other firms is not permitted.

3. The determination of the electric current supplied is effected by the counting apparatus adopted officially—Aron's patent.

4. As the unit for calculating the price is taken that quantity of a current which is consumed hourly by a 16-candle glow lamp. The charge for this unit is $\frac{1}{25}$ s. The cost of the current consumed by glow lamps hourly is about for

| | | | | | | |
|---|---|---|---|---|---|---|
| 8 | candle | glow | lamp | ... | ... | ... $\frac{25}{1000}$ s. |
| 16 | ,, | ,, | ,, | ... | ... | ... $\frac{1}{25}$ s. |
| 32 | ,, | ,, | ,, | ... | ... | ... $\frac{1}{100}$ s. |
| 50 | ,, | ,, | ,, | ... | ... | ... $\frac{1}{10}$ s. |

As in the case of arc lamps (see below, No. 6), it is necessary, from technical reasons, that two 8-candle glow lamps should always burn simultaneously.

Lamps of other luminous power, from 16 to 50 candles, may be burnt singly and extinguished singly.

5. The renewal of the worn out glow lamps is to be paid for by the subscriber quarterly, at the rate of 6s. per lamp yearly. Lamps which are accidentally, negligently, or intentionally broken, or are otherwise made useless, will be charged to the subscriber 6s. each extra.

6. Arc lamps can be used of the following sizes:—

| | | |
|---|---|---|
| I. | 300 — 400 | normal candles. |
| II. | 700 — 800 | ,, ,, |
| III. | 900 — 1,000 | ,, ,, |

Arc lights are calculated as follows:—For two and four small No. I. or two large No. II. or III. arc lights, the subscriber pays 60s. yearly per light as fundamental tax, even if no current is consumed. This charge is paid quarterly in advance; the current consumed is paid for monthly retrospectively upon the footing of the total rate based upon the unit given in § 4.

For more than four small or two large arc lights the current consumed by these lamps is determined by special meters, and the unit as given in § 4 is charged at $\frac{5}{100}$ s.; but the fundamental tax of 60s. is omitted.

The company guarantees that the hourly price per lamp shall not exceed:—

| | | |
|---|---|---|
| I. | ... ... ... ... ... ... | $\frac{5}{10}$ s. |
| II. | ... ... ... ... ... ... | $\frac{5}{10}$ s. |
| III. | ... ... ... ... ... ... | $\frac{6}{10}$ s. |

The arc lights must always be employed in couples, though not necessarily in the same room. If only one lamp is installed the current for two will be charged for.

The subscriber must see to the arc lights himself, and keep them supplied with carbons.

The carbons are to be obtained from the company, and their hourly cost per lamp amounts to $\frac{5}{100}$ to $\frac{8}{100}$ shilling.

7. If the time of burning exceeds 800 hours yearly per lamp, the following discounts—to be arranged yearly—are allowed to the subscriber:—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| More | than | 800 | hours | average | ... ... | 5 | per cent. |
| ,, | ,, | 1,000 | ,, | ,, | ... ... | 7½ | ,, |
| ,, | ,, | 1,200 | ,, | ,, | ... ... | 10 | ,, |
| ,, | ,, | 1,500 | ,, | ,, | ... ... | 12½ | ,, |
| ,, | ,, | 2,000 | ,, | ,, | ... ... | 15 | ,, |
| ,, | ,, | 2,500 | ,, | ,, | ... ... | 20 | ,, |
| ,, | ,, | 3,000 | and | upwards | ... ... | 25 | ,, |

8. For the hire of every counter or meter a yearly charge is made, payable quarterly in advance, according to size, *i.e.*:—

| | | | | | | |
|---|---|---|---|---|---|---|
| Up to | 10 | glow | lamps | ... | ... | 16s. |
| ,, | 20 | ,, | ,, | ... | ... | 17s. |
| ,, | 40 | ,, | ,, | ... | ... | 18s. |
| ,, | 80 | ,, | ,, | ... | ... | 22s. |
| ,, | 120 | ,, | ,, | ... | ... | 26s. |
| ,, | 160 | ,, | ,, | ... | ... | 30s. |
| ,, | 240 | ,, | ,, | ... | ... | 35s. |
| ,, | 320 | ,, | ,, | ... | ... | 40s. |
| ,, | 480 | ,, | ,, | ... | ... | 50s. |
| ,, | 640 | ,, | ,, | ... | ... | 60s. |
| ,, | 800 | ,, | ,, | ... | ... | 70s. |

The hire of the special meters for the arc light is:—

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Up to | 4 | large, | 6 | medium | or | 8 | small | ... ... 18s. |
| ,, | 8 | ,, | 12 | ,, | | 16 | ,, | ... ... 22s. |
| ,, | 22 | ,, | 32 | ,, | | 44 | ,, | ... ... 26s. |
| ,, | 50 | ,, | 75 | ,, | | 100 | ,, | ... ... 30s. |

9. The hire of the meters, the fundamental tax for the arc light, and the annual charge (§ 5) of 6s. per glow lamp is to be paid quarterly in advance, but the amount of the current every month, retrospectively.

10. The installation of the electric appliances in the premises of a subscriber can be effected only after the written permission of the owner of the land has been handed in to the company.

11. The company reserves the right of inspecting every installation from time to time, and of putting such to rights if needful. The subscriber must allow the company's servants to have access for this purpose to all places in which there are meters or any other parts of the installation.

In case of refusal, or if the subscriber makes alterations in the plant without sanction, or does not punctually pay the sums due as above, the company has the right of at once cutting off the current.

## THE GLASGOW GAS ENGINE.

A BRONZE medal was awarded at the Edinburgh Exhibition for the novelty in design of the three-quarter horse-power engine made under Magee's patent and exhibited by the Glasgow Gas Engine Company. A peculiarity of this engine is, that by a patented automatic arrangement the spent products of combustion are entirely expelled after each explosion, so that the explosive mixture is a composition of pure atmospheric air and coal gas which renders the explosion more complete and powerful, while the proportion of gas for each charge is smaller than in engines where a portion of the spent products is left in the cylinder to mix with the charge following. The admission point in the valve shuts off the explosive mixture before the out-stroke is completed; the remainder of out-stroke expands the charge and so abstracts the heat from the walls of the cylinder, thus utilising it and rendering unnecessary much of the cooling arrangement required in other gas engines. At the Mining Exhibition held in Glasgow in the autumn of last year the following placard was hung over the stall of Mr. D. W. Watt, who signed it on behalf of Messrs. Crossley Brothers:—"Challenge to the public—economy of gas—we will guarantee our engine to consume 25 per cent. to 75 per cent. less gas than any other gas engine. We shall be most happy to enter into a public competition with any would-be rival as to consumption per brake horse-power, those losing to pay £100 to any charitable institution agreed upon." The Glasgow Gas Engine Company, thinking the challenge was meant seriously, took it up, and both intimated their wish to test their engine against the Otto and exhibited on their stand the following notice:—"Challenge accepted. The Glasgow Gas Engine Company, Limited, accept the challenge of Messrs. Crossley, and are prepared to abide by the decision of any competent person mutually chosen." From that time to this, however, all efforts on the part of the Glasgow Gas Engine Company to bring off the competition have been fruitless, the challengers shielding themselves behind the allegation that the Magee patent is an infringement of the Otto. The challenge, therefore, would appear to have had nothing more in it than "gas."

## EDINBURGH EXHIBITION AWARDS.

AFTER a prosperous career of six months, the Edinburgh International Exhibition was duly closed with the singing of the National Anthem and Auld Lang Syne on Saturday last. The previous day there was issued an official list of the juror's awards in the sections relating to prime movers and electrical appliances. In the electric lighting department the first place is given to the Thomson-Houston system, a gold medal being awarded to Mr. R. Miller, of Glasgow, the agent for the company in Scotland. The other three arc lighting systems which were in operation in different portions of the building were awarded a silver medal, namely, the Anglo-American Brush Company, the Gülcher Company, and Messrs. J. D. F. Andrews & Co.; a similar award being given to Messrs. King, Brown & Co., for the incandescent lighting and the electric railway. The engineering firms who supplied the motive power for the electrical machinery have been treated uniformly, each being adjudged worthy of a gold medal. Of the six engines which were employed to drive the arc machines, four were by Robey & Co., one by Marshall, Sons & Co., and one by Adamson & Co.; those operating the incandescent machines being all by Marshall, Sons & Co. Messrs. Greenwood and Batley receive a silver medal for dynamos and driving gear, Messrs. R. and J. Dick a bronze medal for lamps and fittings, and Messrs. Norman and Son honourable mention for domestic electric lighting. In addition to these the only awards for electrical appliances are a gold medal to the National Telephone Company for telephone system and fittings, a silver medal to the Rev. T. Calliphronas, of Bagshot, for an electric clock, a bronze to Messrs. Anderson and Munro for electric fire alarm and fittings, and a bronze to Messrs. Adam Miller & Co. for electrical measuring instruments. Messrs. Greenwood and Batley have a gold medal awarded them for the beauty of design and high class workmanship of the Armington-Sims engine, and Messrs. Alley and Maclellan a silver medal for the compactness and high class workmanship of the Westinghouse engine.

## LEGAL.

**Bannatyne v. The Direct Spanish Telegraph Company.**—In the Chancery Division of the High Court of Justice on the 29th ult., before Sir James Bacon, this case was disposed of. It was a motion on behalf of Mr. Neil Bannatyne and all the other holders of preference shares in the defendant company, to restrain the defendant company and its chairman, Sir James Anderson, and Mr. Edmund Etlinger and Mr. J. D. Pender, directors, from acting on a special resolution passed September 30th, 1886, and confirmed on October 19th, to reduce the capital of the company. The company was registered in 1872, its object being to establish direct telegraphic communication between England and Spain by the purchase of a cable already laid down

between the Lizard and Bilbao. The original capital of the company consisted of £130,000, which was divided into 13,000 shares of £10 each. In July, 1884, a special resolution was passed to increase the capital by £60,000. The resolution, the subject of this motion, passed in September, and confirmed in October last, was, estimating the capital at £190,000, to write off one-half of all the shares, preferential and ordinary. The shares consisted at the time of 6,000 preferential shares of £10 each, fully paid up with interest guaranteed at £10 per cent. in preference to the ordinary shares, and 13,000 ordinary shares, of which 12,931 had been issued, and upon which £9 per share had been paid up. The company had power to increase or reduce its capital. Mr. Marten, Q.C., and Mr. H. B. Howard for the plaintiff, said that the effect of the resolution was to increase the value of the ordinary shares at the expense of the holders of preferential shares. Mr. Rigby, Q.C., and Mr. Phipson Beale for the company, and Mr. H. B. Buckley for the directors, opposed the motion. The Vice-Chancellor said the company was formed in the usual way, with power to increase and power to diminish its capital as between the company and the outside world. But what had that to do with the relation between the company and its shareholders? The company borrowed money from the shareholders upon certain terms expressed in the contract entered into between them. There was no doubt as to the contract between the directors and the lenders of the money. The company then desired to reduce the capital by writing off one-half of all its shares, both preferential and ordinary. The question was whether the company, having contracted to pay a fixed interest of 10 per cent. on the preference shares, could by any device diminish that interest. There was no dishonest intention here on the part of the directors, but his lordship had to regard the fact that there were directors of companies who were not so respectable and so pure in their dealings as one could wish. If he allowed this resolution he should give directors an opportunity of raising ordinary shares to bear as good an interest as preferential shares, and should be opening the door to fraud. Giving credit to these directors of a perfectly honest intention, he considered that the resolution to reduce in this manner was not within the powers of the company, and he should grant an injunction in the terms of notice of motion.

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**Harris v. Rothwell.**—Before Mr. Justice Chitty (Monday.) This was a special case in an action for the infringement of a patent, and raised an important question as to whether the deposit of a specification in the German language in the library of the Patent Office in such a way as to be accessible to the public constituted such publication as would avoid a patent subsequently obtained in this country. In the case stated to the court it appeared that the plaintiffs were the owners of a patent obtained in 1880 for certain improvements in knitting machines. In 1877 and 1879 certain specifications and drawings of German patents for knitting machines were deposited in the London Patent Office for public inspection. The specifications were in the German language, and for the purposes of the special case it was assumed that if in English they would, together with the drawings, afford sufficient information to a competent workman to enable him to carry out into practice the invention which was the subject of the plaintiff's patent. Entries were duly published in the *Patents Journal* of the German specifications among those in the list of foreign patents, and they were referred to and classified as knitting machines. A foot note was appended to the list stating that the specifications as well as the list of applications might be consulted at the Free Public Library of the Patent Office. It was submitted for the opinion of the Court whether under these circumstances there was sufficient evidence, if not rebutted, to prove the publication of the German specifications in this realm prior to the date of the plaintiffs' patent so as to avoid the same. It appeared that the two German specifications had been actually open to inspection in the Patent Office Library, the one during some two years and-a-half and the other during some 40 days previously to the date of the plaintiffs' application. Mr. Aston, Q.C., and Mr. W. R. Bousfield, appeared for the plaintiffs; and Mr. Romer, Q.C., and Mr. Goodeve, for the defendant. Mr. Justice Chitty, in giving judgment, said that the question for decision was one of fact, and all that had to be considered was what was the fair inference to be drawn from the facts as admitted in the special case. Had the German specifications been published in this country so as to become part of the stock of common knowledge? The specifications and drawings had been deposited in the Patent Office Library and made accessible to any person who chose to go there. In the *Patents Journal* notice had been given that they could be found in the library. Moreover, the Commissioners had made a classification for the purpose of facilitating search. The inference he made was that the public did avail themselves of the knowledge thus placed readily available. It was not necessary that it should be shown that any person actually did go to the library and inspect the documents in question. That such documents were not in English was a circumstance which was immaterial, for the information given was in a language which was generally understood. He therefore held that either specification amounted to sufficient publication. The costs would be reserved.

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**Literature.**—We understand that a 4th edition of Mr. Kempe's "Handbook of Electrical Testing" will shortly be in the Press.

## ELECTRIC LIGHT AT THE PRUDENTIAL ASSURANCE COMPANY'S OFFICES.

WE have recently had the opportunity of inspecting the successful installation at the above offices put in by the Electrical Power Storage Company, and designed by and carried out under the superintendence of their late engineers, Messrs. Bernard Drake and Gorham, Mr. H. Edlin being the electrician in charge. As we believe this to be the largest venture of its kind that has yet been undertaken, we give a detailed description of it.

There are at present about 1,500 lamps in use, to be increased to 2,000 when the new portion of the buildings is complete.

There are four dynamos, two Crompton of 500 ampères, and two Siemens of 200. For storage there are 528 E.P.S. cells of the 31 R type in glass boxes coupled throughout four cells in parallel.

The engine plant consists of two horizontal engines 35 H.P. nominal, made by Messrs. Marshall, Sons & Co., with cylinders 19 inches diameter, 36 inches stroke, arranged one right hand, the other left, fitted with patent automatic expansion valve gear, and the governors are driven by double belts.

The pistons are fitted with tail guides. The engines are very completely equipped throughout with oiling arrangements for long runs, sight feed lubricators, &c.

The steam is supplied to these engines by three large loco. boilers constructed for a working pressure of 90 lbs. to the square inch, at which pressure the engines will easily develop 110 H.P. The boilers are fitted with steam domes and Cowburn's safety valves.

The escape gases from the smoke box are conveyed in neat down takes to an underground flue, from which they pass to a chimney stack some distance away. An efficient water heater fitted with brass tubes is also arranged in connection with the exhaust to heat the feed water on its passage to the boilers.

In designing this installation, the special requirements of so large a place of business had to be carefully studied. As a large proportion of the lamps were to be of 10 and 12 C.P., and each to be controlled by a separate switch, it was decided to use a potential of only 60 volts. This, of course, necessitated large conducting mains, but it was calculated that the interest on outlay on this account would be more than balanced by the saving in the item of lamps, the life of high potential lamps of low candle-power having been found unsatisfactory.

It was also determined to give up the three-wire system in favour of a single parallel, on the score of the greater simplicity both in wiring the building and after working of the installation.

The next question was to what extent the plant should be subdivided, and this had to be considered in connection with the accumulators. It was not desirable to couple more than four of the largest cells in parallel, which would give a current of 240 ampères in the discharge, and with this arrangement four batteries would be required.

The installation was, therefore, laid down with the four machines above mentioned, a spare pulley being fixed for an extra dynamo should one at any time be found necessary.

The cables from the dynamos run through an insulated trough under the floor to the main switch boards, in the design of which the aim was to render them as simple as possible, and reduce to a minimum the number of parts.

The arrangement adopted enables the number of cells in the charging or discharging circuit to be varied independently, and the current of either to be measured. The switches are all of the "ring contact" pattern, a design patented by Messrs. Drake & Gorham when with the E. P. S. Company, and appear well adapted for the large current which they have to carry.

Apart from the switch boards there are terminal boards fitted with interchangeable connectors, by means of which any of the dynamos or batteries can

be coupled to any circuit of lamps. The dynamos are all fitted with loose pulleys, so that in the event of a hot bearing, there would be no necessity to stop the engines.

The accumulator cells are arranged in tiers, and attachments fixed to enable a portable lamp with flexible wire to be readily attached for inspection purposes. The battery rooms are carefully shut off from the engine room, a very necessary precaution when accumulators are used, to prevent rusting of the bright parts of the engines and damage to the insulation of the dynamos.

Fusible plugs are fixed in the mains, branches and each lamp circuit, fine copper wire being used in preference to lead or alloys which have been found unreliable after long use.

On each of the floors a main switch is provided, so that the lamps on that floor can be extinguished without the necessity of sending to the engine room, in some cases a considerable distance.

One remarkable feature of the installation is the extensive use of bare copper strip for the main conductors outside the building. This is carried by saddles supported by special insulators designed by the engineers, and the result has fully answered their expectations, the insulation being exceptionally high while the cost of the conductors is much reduced.

The branch cables from these conductors are carried through wall boxes run in with pitch, and the joints boxed over for protection from rain.

## NOTES.

**The Electric Light at the Vatican.**—The Vatican is to be supplied with the electric light. The dynamo machine is being made, and the entire apparatus will be so far advanced by the end of the year that a start can be made with the installation. The Pope is much interested in the experiment, which he has been contemplating now for some time.

**A Submarine Electric Search Light.**—The steam yacht *Chick*, owned by Messrs. Alley and Maclellan, engineers, Glasgow, which has arrived at Port Glasgow for an overhaul, is being fitted up with an apparatus and machinery for the trial of a patent for lighting by electricity under water. The apparatus is of a most costly description, but if successful, which it is fully expected to be, results will be something marvellous, as it can be used not only in the examination and lifting of wrecks, but also in fishing and the recovery of articles lost under water.

**The Electric Light in Marseilles.**—The gas company of Marseilles is erecting a central station for the distribution of electricity, and proposes to introduce the light into all the cafés and restaurants along the Cannebiere. The station is situated in the neighbouring Rue Pavillon.

**The Electric Light in Berlin.**—The annual report of the gas works in Berlin contains some interesting facts about electric light installations. In all there are 152 installations in Berlin, containing 736 arc lamps and 12,705 glow lamps. Gas engines are used in thirty installations, and the rest are either worked from central stations or use steam power on the premises. The Städtische Elektricitäts Werke have alone 5,499 glow lamps and 27 arc lamps in use.

**Another Miner's Electric Lamp.**—Mr. Miles Settle, of the Madeley Coal and Iron Company and the Leycett collieries, whose name is well known in connection with the water cartridge, has, *Industries* states, invented an electric safety lamp, of extreme simplicity in construction and of great efficiency in operation. Experiments are being made with it in the mines under Mr. Settle's management.

**Electric Lighting of Trains.**—Electric lights have been used for three months past in a dining car running between Paris and Brussels. The electricity is supplied from the constant batteries of Desruelles. Forty-five of these in fifteen boxes, weighing nearly 1,400 lbs., are attached under the car. They are said to afford light for 70 hours to 21 lamps with 100 aggregate candle-power. The light is very steady for the first 20 hours, and then begins to grow weaker. It is remarked that to supply the same light from an accumulator nearly twice the weight would have to be carried.

**The Electric Light at Colchester.**—Mr. George Offor recently wrote to the *Daily News* complaining that soon after commencing practical lighting at Colchester the enterprise was fatally injured by the unfortunate action of a section of the shareholders in the company, who had lost all confidence in electric lighting as a commercial success, and succeeded in reducing the capital of the company by about one-half in order to get clear of the liability for calls. The discussions which took place at the general meetings were reported in the Colchester papers; confidence in the stability of the company was shaken, and many intended users of the light withdrew their orders. But the experiment proved that, with a moderate trade—say, three millions lamp hours per annum—the electric light could be supplied at the equivalent of 5s. per thousand cubic feet for gas, and pay the company at least 12½ per cent. upon the capital employed, after making full provision for depreciation of plant. The station at Colchester was worked uninterruptedly until about two months ago, when a local company, to whom the plant had been sold, abandoned the enterprise, owing to the small amount of business guaranteed by the inhabitants. What is required is the necessary capital for providing central stations for house-to-house lighting. A practical system was proved at Colchester, and, with the more perfect appliances now available, can be carried out with success in any district where a sufficient demand exists. The Electric Light Act requires serious modifications, but this need not prevent the lighting of groups of houses from a central station where the public roads are not used.

**Proposed Electric Lighting at Hanley.**—Mr. J. E. Doyle, Midland agent and engineer to the Maxim-Weston Electric Company has taken advantage of the recent debate on gas matters in Wolverhampton to write the following letter to the *Midland Evening News*:—"In reference to the gas debate read in your last evening's edition, it should be known that the Hanley Town Council are going to instal the electric light over a very considerable area. The newspaper published in the gas interest calls this a 'fad,' an 'absurdity.' Time will tell. As to the enhanced price of gas in Oldbury, West Bromwich, and Smethwick, it should be considered that each of these properties covers immense tracts of country. Oldbury takes the mains in one direction towards Blackheath and The Rowleys, and in another through Langley towards Quinton—the latter a stretch of some five or six miles. The same description nearly applies to the other two towns. It must have been a ruinous 'spec' if the outsiders were not content, and in numerous cases volunteered stiff extra prices for the convenience."

**A Hint to Penzance.**—The *Western Morning News* says:—"Whether the electric light be adopted or not for illuminating the Penzance promenade, some steps ought to be taken, without much delay, to provide better arrangements than at present exist for lighting the promenade and several other of the much frequented public thoroughfares of Penzance. The town is certainly badly lighted in many places. The authorities seem to adopt a system of false economy in connection with the public lamps. An arrangement apparently exists at present whereby at the seasons when the moon is supposed to be sending forth her rays a number of the lamps remain unlighted. This is all very well when the moon actually does shine upon Penzance; but on

many nights in the winter time the sky is so clouded that the lunar illumination is impeded, and darkness reigns. On such occasions pedestrians have to grope their way about in many parts of the town. But the promenade is at all times insufficiently lighted."

**An Electric Lighting Difficulty in Berlin.**—The *Gas World* says that electric lighters in Berlin have been getting into a curious trouble. In Berlin people live in flats, and there is sometimes a courtyard common to a set of flats. A gas engine was put in a cellar in order to light up a certain range of apartments; the police were called in to interfere because the gas engine and dynamo made a noise at night. The authorities insisted that that gas engine must become silent at 11 p.m. The trouble was not yet over; one of the neighbours was a lady; she brought up the owners of the offending engine, and charged them with causing an insufferable heat and stench of oil in the courtyard, thus rendering it impossible for her to keep the hotel as she wished. After an hour's debate, the Court decided to stop the engine altogether under a penalty of £100 per day.

**Electric Lighting at Tavistock.**—On Saturday evening the inhabitants of Tavistock were afforded an opportunity of witnessing the utility of the electric light for street lighting purposes, and large crowds thronged the thoroughfares, which were illuminated for experimental purposes by Messrs. Laing, Wharton, and Down, who will continue the installation for fourteen days. A local committee composed of representative tradesmen made the arrangements for fixing the wires, and Messrs. J. & H. Pearce kindly allowed the dynamo to be placed in their yard and worked by their turbine. The result was in the highest degree satisfactory, Mount Tavy Road, Vigo Bridge Road, Brook Street, Duke Street, and Bedford Square, being illuminated by a brilliant and steady light, which imparted a very favourable impression to the public. On Monday, the light was extended to West Street, where ten arc lamps each of 1,200 candle-power were called into requisition. The prospects of a general adoption of electricity appear to be extremely rosy.

**Electric Lighting at Bournemouth.**—The Bournemouth Commissioners have granted permission to Messrs. Mortimer, Shepherd & Co., who propose to introduce the electric light into the town, to run their wires through the various thoroughfares and to light the pier for a month or so, as an experiment, by three systems, at their own expense. One or two members strongly protested against the increasing number of overhead wires in the town, due to the growth of telephonic enterprise, and an opinion was expressed that the place would soon become like a spider's web.

**Electric Lighting at Halifax.**—In a note, taken from a local paper, in our last issue it was stated that the Woodhouse & Rawson Company was erecting an electric light installation at Messrs. L. Crossley and Company's premises at Halifax. Messrs. Goolden and Trotter write to us that, presuming the statement refers to the firm of Messrs. John Crossley & Sons, Limited, they are in a position to inform us that this company, having an electrical department of its own, is probably in a better position to carry out its own installation than any other textile firm in England, and that the only dynamos on the premises, with the exception of some early Brush machines, have been supplied by themselves.

**Electric Light at a Bicycle Club Concert.**—Saturday being the last run of the season the Lewisham Bicycle Club celebrated the event with a smoking concert. The whole of the club house was brilliantly illuminated with incandescent lamps, the current being taken from storage cells supplied from the works of Messrs. Arthur B. Gill & Co., electrical engineers.

**Electric Lighting of the Athenæum Club.**—The Athenæum Club was opened on Sunday week, after having been closed during five weeks for the installation of the electric light, which has been carried out by the Edison-Swan Company. The library and every room in the house are now fitted with the new light.

**The Electric Light in Trinidad.**—The citizens of Port of Spain have recently been discussing the advisability of adopting the electric light for the illumination of the streets, but the Trinidadian *New Era* of October 4th seemed to anticipate that "prudent counsels would prevail and the day of change from oil lighting be postponed indefinitely. It strongly urged such postponement on the ground that "whatever may be said of the science of electricity, the art of electric lighting is yet in its infancy," and that "the men who are now making scientific enquiry into the subject of electric lighting do not impress the world at large with the belief that they have as yet exhausted their mission." Mr. Raymond Warner had made a proposal to light the borough by electricity at a cost of $11,604 per annum, provided he was granted a twenty-one years' concession; the present yearly cost for lighting by kerosene is $8,258. "His worship the Mayor," when the matter came before the Council, was strongly of opinion that the difference might be better spent than in electric lighting, and said that if the latter method was the best it certainly was not the cheapest. Other members seemed to take the same view, but eventually a committee was appointed to deal with the matter.

**Electric Lighting in the Navy.**—Last week the official trial of the electric installation on board the Indian troopship *Dalhousie*, took place on the voyage between Greenock and Birkenhead. The installation consisted of 168 Edison-Swan lamps of 20 candle-power, and 16 lamps of 50 candle-power arranged in two yard-arm reflectors. The dynamos were two Goolden-Trotter A type, driven direct by Willan's three cylinder compound tandem engines at 300 revolutions, each capable of maintaining the entire number of lights. The engines were started on the full installation at 10 a.m. on Thursday morning, and ran without intermission for 54 hours at full load, the vessel being at sea during the last 24 hours of the run. The engines and dynamos ran faultlessly while in harbour, but the value of the test at sea was shown by the detection of a defective arrangement of the connection of the steam pipes with the boiler, which allowed water to reach the engines when the vessel was under weigh, and at times gave some trouble. So far as the electrical details were concerned, however, the lighting was a pronounced success, and when the fault in the steam connection is remedied by the builders the installation will be perfect. The entire work was carried out without assistance by the firm of Goolden and Trotter, of Westminster, the ship being fitted on Admiralty specification under the supervision of Mr. Scott, their superintending engineer. The *Dalhousie* and the *Lawrence*, which we mentioned last week, were finished together in twelve weeks from the commencement. The lamps gave a light of 20 candles at 80 volts, though marked 16 C.P., taking an average of 73 watts, thus showing an actual efficiency of 3·4 watts per candle, and nominally of 4·45 watts per candle. Mr. Jopp, Director-General of Stores, inspected the installation on the arrival of the vessel at Birkenhead. Both ships sail for India this week, and are the first vessels of the Indian Marine which have been fitted with the electric light.

**Electrical Lighting in Bradford.**—Bradford is promised something of a novelty in the shape of bazaars this winter. They will be held in St. George's Hall. The light in that building is not bright at the best of times. On winter days it closely approaches semi-darkness. The promoters of the bazaar have therefore decided to dispense with daylight altogether. A large tent will rise from the galleries to the ceiling, blocking up all the windows, and the building will be lit all day long

by powerful incandescent lamps. Permission has been obtained to place an engine in the yard of the West Riding Police Court to work the dynamo.

**International Telephone Exhibition.**—An exhibition of telephony will be opened in the rooms of the Société Belge des Ingenieurs et des Industriels, on January 9th, 1887. The object of the exhibition is to bring together all apparatus for transmitting the human voice to a distance and their applications, and to demonstrate the progress which has been made in telephony up to the present time. Its character will be scientific and practical. It will comprise: Telephones, microphones, radiophones, phonographs; apparatus used in connection with these, as telephone posts, &c.; systems of central offices and their elements, telephonic rooms; conductors and the method of installation; special tools in use in telephone work; in general, all telephonic systems, and specially anti-induction systems; systems of transmission by cables of several conductors; long distance systems; system of simultaneous telephony and telegraphy. In the Exhibition will also be shown, by means of apparatus, models, plans, diagrams, &c., all new processes, as well as the advantages of these processes and their peculiarities. A bibliographical section, comprising published works on telephony and statistical documents, will form a part of the Exhibition.

**Portsmouth Telephone Exchange.**—On Monday all night communication was granted by the Telephone Company, the members of the exchange now mustering 85. The extension of time was generally appreciated, as it enabled the results of the Municipal elections in the various wards to be telephoned to different parts of the borough.

**Telegraph Revenue.**—The receipts on the telegraph service from April 1st to October 30th, 1886, amounted to £1,090,000, against £1,080,000 received from April 1st to October 31st, 1885.

**French Cable.**—A Reuter's telegram states that the Portuguese Government has authorised the French cable to Madagascar being landed at Mozambique, which will therefore be one of the stations of the new line.

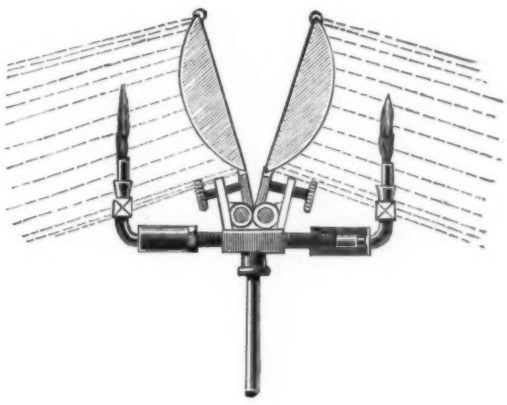
**The New Zealand Cable Subsidy.**—In consequence of the refusal of the New Zealand Government to continue the subsidy hitherto paid to the Eastern Extension Telegraph Company, the company has increased the tariff for inter-Colonial telegrams between Sydney and Nelson from 6s. to 10s. per 10 words, and the Government having also raised the terminal rate, the total rate is now 14s. 6d. per 10 words from Australia to New Zealand, whilst in the reverse direction it is only 10s. 6d.

**The Saltaire Exhibition.**—The arrangements for holding the exhibition at Saltaire, which had to be postponed last year, are now in active progress. The original plans have undergone some alteration, but the exhibition which is now officially named the "International Exhibition of Art, Science, and Industry," 1887, is not likely to lose any of its attractiveness from the proposed changes. It is intended to set aside 50,000 feet of floor space in the permanent buildings for exhibition purposes, and temporary annexes will supply nine courts, each 100 feet by 50 feet, which will be occupied by machinery in motion; a principal court, 450 feet by 60 feet for general exhibits; a concert-hall, conservatory, dining-rooms, cafés, &c. Landscape attractions covering six acres of ground will surround the buildings. Arrangements are being made for illuminating the grounds and buildings by electricity, and there will be an electric railway. The present contract provides for 200 arc lamps of 2,000 candles, and 600 incandescent lamps of 20 candles, but arrangements have been made with the contractors—Messrs. Woodhouse & Rawson—whereby the number of lamps may be increased. The motive power will probably be supplied by five large engines, which Messrs. John Fowler & Co., Leeds, have undertaken to supply.

**The Electric Locomotive and Power Company.**—Mr. Radcliffe Ward writes:—"Mr. Elieson distorts the meaning of my letter. My letter clearly stated that it was the motor running round on a table, in addition to its proper motion round its axis, with the *additional* power required therefor, that I did not wish to be considered an advocate of. This is a totally distinct matter to the arrangement whereby the difficulties of starting, ascending inclines, rounding curves, &c., are overcome. Anyone sufficiently interested in the subject can check the accuracy of my previous letter by referring to the specifications named. I am sorry that my wish not to harshly use my advantages is not appreciated. Every opportunity has been given to the company to show that the points of Mr. Elieson's patent above referred to, and previously patented by me, are not being put into use by them, but they have declined to do so."

**Electro-Motors and Generators.**—Mr. Esson proves experimentally what has long been known, viz., the fact that an efficient dynamo is also an efficient motor; but has Mr. Esson ever used an electro-motor for the purpose of generating electric currents? By electro-motor, we mean a machine which has been constructed purposely to produce a maximum useful effect with a minimum amount of material. It would be interesting to know the size, weight, and power of the dynamo machine used in the experiments which formed the basis of Mr. Esson's arguments.

**A Hint for Electric Lighting.**—Writing to the *Engineer*, Mr. John G. Winton says:—"Not until each street lamp is turned into a miniature light-house, distributing the rays of light from the gas by reflection or refraction, can we say that gas has been fully utilised. We have many lamps burning a great quantity of gas, giving off a powerful light, and reflected in bright patches immediately under the lamps, while between the lamps is in comparative darkness. Amongst many plans we have devised for the all-round system of lighting by reflection or refraction, we consider, for narrow streets,



throwing the beams of light right and left along the pavement to be preferred, allowing the gas of itself to light across the street, and which is aided by the spreading of the rays from the double lenses, as per engraving, which we have practically tested in one of the lamps at the municipal buildings here, which we have been kindly granted the free use of by the authorities. There are two convex lenses placed closely together at the bottom, with the convex surfaces inclined downwards, and which can be set at any angle that may be determined on with the small set screws as shown; likewise, the jets can be adjusted as shown, but this may be entirely dispensed with on ordinary occasions, the lenses and jets being quite rigid and immovable. The gas jets are placed in front of the lenses and are always visible. The rays from the one are refracted through the convex surface, and, being caught up by the other lens, are refracted downwards on the pavement at any

angle that may be desired. It will thus be seen that the rays from the one light are refracted through the other light, and *vice versâ*. With this plan there are no shadows as with reflectors. A stream of soft light is thrown right and left along the pavement, and partially distributed across the street, and is by no means hurtful to the eye, while the gas of itself lights up the foot of the lamp and across the street. The gas remaining always visible is the main feature in this arrangement. We may mention that the lenses are 4 inches in diameter, but would recommend 6 inch lenses as preferable."

**Gas Explosion in a Church.**—The preacher at a service held on Wednesday evening last week at St. Thomas's Church, Kendal, had a narrow escape of being blown out of his pulpit. He had just finished his sermon, and had left the pulpit, when the congregation were alarmed by a loud explosion, and a portion of the pulpit became enveloped in flames. The people hastily left the building, and it was afterwards found that the explosion was due to a serious leakage of gas under the pulpit. Let us hope that the Revd. gentleman will now call in the aid of electricity for illumining the sacred edifice.

**Obituary.**—The death is announced of Dr. Guthrie, Professor of Physics at the Normal School of Science. The *Academy* says: "As Professor of Physics at the Normal School of Science and Royal School of Mines, Dr. Guthrie was widely known in scientific circles, where his geniality and humour made him a general favourite. He was born in London, in 1833, and obtained his scientific training chiefly at Marberg and Heidelberg. As a young man Dr. Guthrie was assistant in the chemical laboratories of the University of Edinburgh and Owens College, Manchester; and in 1861 he became Professor of Physics in the Mauritius. He was the author of an excellent text-book of electricity and magnetism, and of a large number of scientific memoirs, partly chemical and partly physical. Many of his researches were marked by much originality, dealing with obscure problems in molecular physics, and adding to our vocabulary such words as *eutaxis* and *cryohydrates*. Professor Guthrie was a commanding figure in the Physical Society, which held its meetings in his lecture room at South Kensington. It is but a short time ago that he delivered before the Society of Arts a course of lectures in which he dealt in a characteristic manner with the subject of scientific education. A few months back Dr. Guthrie was attacked by a serious disease of the throat, to which his death, at the age of 53, was indirectly due."

**Storage Batteries.**—More than 25 years ago, the *Electrician and Electrical Engineer* of New York states, Charles Kirchoff devised an apparatus which was the forerunner of the present storage battery. He drew attention, amongst other things, in a patent issued to him in the United States in 1861, to the desirability of roughening the plates and perforating them so as to gain increased surface for action, and he recognised a great value for lead and its peroxide as the active materials, on account of their electric potential differences. Although the battery is described by Kirchoff as one in which platinum plates are used and lead plates are suggested, the platinum is only employed as a base upon which the peroxide of lead and lead are respectively deposited.

**Glasgow Exhibition, 1888.**—Incited by the success of this year's International Exhibition at Edinburgh, the Glasgow people have determined to hold a National Exhibition in the West End Park in 1888, and the subscriptions to the guarantee fund already exceed £70,000. A public meeting of the citizens was held on Friday last, at which certain preliminaries were decided upon and a general council appointed. The portion of the park to be enclosed for the purpose is 39 acres in extent, and the buildings as at present designed will cover about 8½ acres.

**The Society of Telegraph Engineers and Electricians.**—The first meeting will take place at the Institution of Civil Engineers, 25, Great George Street, S.W., on Thursday, November 11th, 1886, at 8 p.m., when a paper on "The predetermination of the characteristics of a dynamo," by Gisbert Kapp, associate, will be read.

**Manchester Royal Jubilee Exhibition.**—The executive of this exhibition which opens early in May next, have addressed a memorandum to foreign exhibitors pointing out that the object in view is to illustrate the progress made in the development of the arts and manufactures during the Victorian age, and that it has been arranged that all exhibits whether British, Foreign, or Colonial shall be displayed side by side in the various sections, irrespective of nationality. In the opinion of the committee this arrangement is best adapted to secure the dissemination of information as to the respective merits of the exhibits. Equal facilities will be granted to British, Foreign, and Colonial exhibitors, and no special favour will be shown to anyone. The latest date for receiving application for space from foreign exhibitors is December 1st, 1886, and to meet the wishes of several home exhibitors the time for receiving applications from them has been extended to the same date. It has also been decided to make no charge for steam or belt power. Amongst the processes to be exhibited in the section devoted to silk industry, will be that of printing silk by electricity. Electrical instrument making will be one of many handicrafts to be shown in operation.

**Fire Insurance and Electric Lighting.**—We expect there is a great deal of truth in what our correspondent "Resistance" states. Long, long ago we drew attention to the numberless absurdities contained in the "rules and regulations" of a well-known fire office, which we believe had been drawn up by a gentleman whose experience of electrical matters was limited.

**The Ferranti Transformers.**—Our readers can see by glancing through our Correspondence columns that action has been commenced by Messrs. Gaulard and Gibbs against the system which has supplanted theirs in the Grosvenor Gallery. What good purpose can be served by this method of procedure we are at a loss to understand; but then these gentlemen know their own business best, we suppose.

**Spiel's Petroleum Engine.**—At the Birmingham Exhibition a good illustration is afforded of the capabilities and excellencies of this engine for electric lighting purposes. A two horse-power engine is shown by the makers, Messrs. A. Shirlaw & Co., of Suffolk Works, Birmingham, working a No. 1 Gulcher 50 light dynamo, which runs quite steadily without the fly-wheel on the dynamo which is usually found necessary when a gas engine is employed. Thirty 20 C.P. lamps are fed without any perceptible unsteadiness or variation. The size of this engine is 7 feet 3 inches by 3 feet 7 inches, and of the water tank 5 feet 6 inches by 2 feet 9 inches, and the weight of the engine with the base plate under 26 cwt. When exerting its full power, the consumption of petroleum is about one pint per horse-power per hour, equal to a cost of less than one penny per indicated horse-power per hour. In this engine the petroleum is not used in a vaporised condition but in its fluid state, and with ordinary care there is less risk than with a gas engine. The steadiness and uniformity of speed render this engine particularly suited for driving dynamos, and for country-house lighting it is likely to be in demand.

**Magnetic Fields.**—The paper which we publish this week by M. Marcel Deprez is of considerable importance to those engaged in dynamo construction, and if his results are trustworthy, it appears as if our electrical text-books will require revising in certain parts. It will be noticed that M. Deprez claims the particular construction of magnetic field, such as is now employed in the Edison-Hopkinson machines and others.

**Curious Lightning Accident.**—Recently a peculiar accident occurred at Ryde, Isle of Wight, during a thunderstorm. The telegraph wires between the railway terminus and the pier head were struck, rendering them utterly useless. Two officials who were standing near had narrow escapes. The lightning was conducted to two small batteries at the end of the pier, whence it flashed out striking a small leaden pipe with such force as to penetrate it, lighting the gas. Then it returned to the earth leaving a mark where it struck, close to the spot where a collector and a lad were standing.

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**Electricity in the Royal Navy.**—On Tuesday a Whitehead torpedo of the old-fashioned 16 inch pattern was exploded by means of an electrical current against the side of the obsolete frigate *Resistance*, which is being subjected to a series of experiments at Portsmouth; and on Wednesday six submarine mines containing each five hundred pounds of gun cotton were exploded by the same means at Spithead. The ironclad *Invincible* is being fitted at Devonport with four electric search lights, two forward and two aft.

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**Telephone Suit.**—Judgment in the action of the Stanhope Company *v.* Messrs. Russell and Hope, to which reference was made in our issue of October 22nd, has been given in favour of the plaintiffs for the amount claimed, together with costs.

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**The Marchant Engine.**—We do not think that Mr. Marchant will advance his cause by penning long letters to the technical press, more especially when much of the matter contained therein is of an irrelevant nature. What we require now is a test which shall either corroborate or refute the figures obtained by us, and the sooner this is done the better. We understand that a Marchant engine of 15 horse-power is being constructed upon a somewhat different principle, whatever this may mean, and which is to give still better results, but the point at issue is the engine in the works of Messrs. Frazer, at Bow, and until this is cleared up we think Mr. Marchant is ill advised to turn his thoughts to anything else. We have already suggested the names of experts with whom our contemporaries could have no fault to find, but we do not hear that any steps have been taken to engage the services of these gentlemen to report upon the Marchant system. We hope, before our next issue, to have another run with the engine, eliminating the blocks E and F under the lower half of the brake. It would be particularly interesting to drive an Edison-Hopkinson dynamo, such as that tested some time since at Mather and Platt's, from the Marchant engine. As this dynamo gives an output of something between 90 and 100 horse-power, fairly accurate results could readily be obtained, and surely, in the interests of electric lighting, some firm might be found willing to lend one, two, or even three dynamos to approximate to a total of 100 horse-power for such an important object.

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**Serious Gas Explosion.**—An explosion of gas, which seriously injured two servants and caused great damage to property, occurred at the town residence of the Earl of Lathom in Portland Place on Tuesday afternoon. The family were out of town and the house was closed; indeed, it seems to have been almost hermetically sealed, and after the gas had been allowed to accumulate for several hours a match was applied with a result which might have been anticipated.

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**The Royal Society.**—We understand that the Royal Society now has an installation of 60 incandescent lamps, an Elwell-Parker "7 unit" dynamo, and E.P.S. storage cells sufficient for all the lamps. The work has been carried out by the Electrical Power Storage Company, and the motor used is the gas engine presented to the society by the late Sir William Siemens.

**The Immisch Electro-Motors.**—We hope shortly to place before our readers some information respecting the Immisch motors, which appear to be coming rapidly into favour. We have already had the pleasure of inspecting the new and extensive works of Mr. Immisch, where everything is being arranged for carrying out large contracts either in motors or dynamos. Mr. Immisch has also a system of gearing for electrically propelled tramcars, and he is now engaged in carrying out experiments on a practical scale for the purpose of obtaining reliable data in connection with electric locomotion.

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**The Transmission of Motive Power.**—We hear it rumoured that the Birmingham scheme for supplying motive power by compressed air has fallen through. Will the subject be taken up again with electricity as the source of supply? Unquestionably the chances of success would be greatly enhanced.

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**The Prudential Assurance Company.**—Particulars of the electric light installation in the offices of the Prudential Assurance Company are announced in our other pages. After an examination of the place, we have no hesitation in saying that here may be seen one of the finest examples of electric lighting in London, and Messrs. Bernard Drake and Gorham, who designed the arrangements and carried out the whole of the work for the Electrical Power Storage Company, deserve immense credit for successfully dealing with an installation, the vastness of which might have made older men dubious as to the result. The lighting, which is to be still further extended, presents several points of novelty and interest.

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**New Dynamos.**—We hear that Messrs. Siemens Brothers are now constructing their machines on the lines of the Edison-Hopkinson model. We suppose that eventually they will all closely approximate to one another in design, for there are now a considerable number of obsolete machines.

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**The Temple Church Lighting.**—Messrs. Mortimer, Shepherd & Co., have fitted no less than three temporary installations of the electric light in this church. The first was to decide, practically, the best position and number of lamps; secondly, on the occasion of the visit of the Princess Louise, when the body of the church was fitted with 10 very simple and neat wrought iron chandeliers for five lamps each, suspended between columns on temporary tie-rods, and four similar chandeliers for three lamps each, suspended from arches in the round tower; and thirdly, with four lamps fitted one at each corner of the capitals of the columns, and four three-light chandeliers suspended from arches in the round tower.

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**The Incandescent Lamp Question.**—We beg to remind our readers of the meeting of the trade convened for Monday next at three o'clock at the Cannon Street Hotel. Messrs. Woodhouse and Rawson have already received such promises of support, that those who are desirous of securing free trade in lamps have only to make this one determined effort to place themselves in a very favourable position for achieving this desirable object.

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**The Stanhope Telephone.**—At a bazaar held on Tuesday and Wednesday the 2nd and 3rd inst., at Stoke Newington, in connection with the West Hackney Mission School, the Stanhope Company kindly lent for the occasion a pair of their New Patent Telephones, the wires being run between two of the rooms. An entire absence of buzzing and the clear articulation of the telephones were very noticeable properties.

**Gas Engines for Electric Lighting.**—At the Brewery Exhibition at the Agricultural Hall last week, Messrs. Heap and Stuart showed two Pilsen arc lamps running. These were driven from a Schuckert dynamo off the flywheel of a Stockport gas engine. The same firm showed eight Swan lamps of 10 C.P. driven from a small "Chaster," the motive power being a Bischoff two-man-power gas engine. This is interesting, as being the first time that either of these makes of engine has been used for electric lighting. In both cases, however, the light was brilliant and steady, with the normal gas consumption.

**Newcastle Exhibition.**—The Executive Committee of the Mining, Engineering and Industrial Exhibition, to be held in Newcastle next year, have issued an announcement that they have decided to provide more space than originally intended, and that the time for receiving applications is extended to 30th November.

## NEW COMPANIES REGISTERED.

**Standard Time.**—Capital £100,000 in £1 shares. Objects: To acquire patents relating to the regulation of time by electricity and for the transmission, accumulation and dispersion of electric currents and force. To manufacture telephones and to establish exchanges. Signatories (with one share each): *The Hon. Ashley Ponsonby, J.P., 9, Princes Gardens, W.; *General A. Fraser, 96, Holland Road, S.W.; *R. Crawley, 45, Great Marlborough Street; *Latimer Clark, C.E., 6, Westminster Chambers, S.W.; *F. H. Fowler, 9, Serjeant's Inn, Temple; J. A. Hilliard, 75, Cornhill; F. Aysom, Holly Park, Crouch Hill. Directing qualification: 200 shares; remuneration, £600 per annum and a further sum equal to 5 per cent. on the profits in excess of sufficient for the declaration of 7 per cent. per annum dividend. The first five signatories are appointed directors. Registered 28th ult., by Messrs. Stretton, Hilliard & Co., 75, Cornhill.

**Singapore, Straits Settlement and Siam General Electric Company, Limited.**—Capital £60,000 in £5 shares. Objects: To carry on in the Straits Settlement and Siam the business of a general electrical company, including therein lighting, telegraphy, telephony and the manufacture and supply of electric appliances and plant. Signatories (with one share each): Major-Gen. W. Ryrie Alexander, Dartmouth; J. R. Morriss, 17, Adam Street, S.E.; J. Walton, 11, Jamaica Road, S.E.; W. E. Death, 20, Bucklersbury; Robert Henderson, 26, Budge Row; W. H. Le Fevre, C.E., 26, Budge Row; W. L. Madgen (electrical engineer), Surbiton Hill. Directing qualification: 20 shares or £100 stock. The signatories are to appoint the first directors. The board may delegate any of their powers (except that of making calls) to a committee consisting of shareholders residing at Singapore. The members of the first committee are Tan Kin Ching, Saimese Consul, Syed Mahomed Bin Alsagoff and W. B. Smith. The remuneration of the board will be £300 per annum and that of the committee £150 per annum. Registered 1st inst., by Mr. E. Schuberth, 139, Cannon Street, E.C.

## OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

**United Telephone Company of the River Plate.**—The annual return of this company, made up to the 26th ult., was filed on the 29th ult. The nominal capital is £200,000 in £5 shares. 20,417 shares have been taken up, and the full amount has been called thereon. The calls paid amount to £102,080, and unpaid to £5.

## CITY NOTES, REPORTS, MEETINGS, &c.

### The Pilsen-Joel and General Electric Light Company, Limited.

AN extraordinary general meeting of this company was held on Tuesday at the City Terminus Hotel, Cannon Street, Sir Rawson W. Rawson, K.C.M.G., C.B., the chairman, presiding.

The notice convening the meeting having been read,

The Chairman explained that the proprietors had been called together for the purpose of passing a special resolution, which, if adopted, he believed would place the company upon a much sounder basis. He then moved the resolution in the following words:—"That if an order of the Court be obtained for confirming this resolution, the capital of the company be reduced by cancelling the sum of £1 per share in the 28,000 shares of the company, of £3 each with £2 5s. called up thereon, and the sum of 35s. per share on the 100 fully paid up shares of £4 each, as being capital which had been lost, or is unrepresented by available assets, and that the memorandum of association of the company be modified so as to carry into effect this resolution." He said it was a matter of great satisfaction to himself that he was at last able to express his belief that the shareholders were about to get some return for their investment. The directors fully believed that they saw their way to giving the shareholders some return for their money, although a modest return it must always be as long as lighting by arc lights was so little sought after by the public. They had, however, during the past three years maintained a firm position, and they had established the excellence of their arc light. The enterprise of late had been a success, and if they reduced their capital there was little doubt but that they would be able to pay a dividend. The £28,000 they proposed to write off would not affect the value of their property, because it was really money that had already been lost. They desired to cut away this dead weight and throw it overboard. They would then trim the ship and look forward to a favourable breeze, which would take them into calm water and enable them to go sailing quietly and joyfully along.

Major Scriven seconded the resolution, and said the shareholders would be glad to learn that during the past year the income had been sufficient to cover all disbursements.

The motion was put and carried, and a vote of thanks having been passed to the chairman, the proceedings closed.

### Cassel Gold Extracting Company, Limited.

AN extraordinary general meeting of the shareholders of the Cassel Gold Extracting Company was held at Glasgow on Friday last, when the directors stated that it might be necessary for the company to return to the careful examination and development of its process. The company had ample means to do so, as out of the capital already called up there remained over £10,000 on hand, and the capital of the company uncalled amounted to upwards of £50,000. The directors considered that this experimental stage of the future operations of the company should not involve any very great outlay, and it had been represented to them that they should not therefore make in the meantime further calls upon new shareholders. They felt that the real blame of recent transactions lay upon Mr. Cassel. It might be that the company, if the process proved successful, would be all the better for also finding at that early stage that they could not trust to the inventor. Such experience was by no means uncommon, and assuredly if independently the company perfected the process its position would be stronger than ever. Mr. D. Murray and Dr. Liepmann, who went to America on behalf of the company, also submitted a report, after which the following resolution was passed:—"That this meeting remit back the special report of the directors, and the report of Messrs. Murray and Liepmann, and ask the directors to consider what step should be taken regarding the American contract and the making of calls; and also to recommend to the directors the propriety of making additions to the board, and of removing the works of the company from London to Glasgow."

**Consolidated Telephone Construction and Maintenance Company, Limited.**—The directors have declared an interim dividend of 2½ per cent. on account for the current year, and the same will be payable on and after November 15th next.

## TRAFFIC RECEIPTS.

The Cuba Submarine Telegraph Company, Limited. The number of messages passing over the lines of this company during the month of October was 2,783, estimated to produce £2,400, against 2,604 messages, producing £2,156 in the corresponding month of last year. The receipts for the month of July, estimated at £2,800, realised £2,818.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending October 29th were £3,307 after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

The Eastern Extension, Australasia and China Telegraph Company, Limited. The receipts for October amounted to £37,185 against £43,986 in the corresponding period of 1885.

The Direct Spanish Telegraph Company, Limited. The estimated receipts for the month of October were £2,013 against £1,756 in the corresponding period of last year.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended the 31st October are £2,091, as compared with £1,942 in the corresponding period of 1885.

The Eastern Telegraph Company, Limited. The receipts for October amounted to £49,574, against £56,994 for the corresponding period of 1885.

## ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1886.

1726. "Improvements in the manufacture of incandescence electric lamps." L. S. POWELL and R. P. SELLON. Dated February 5. 8d. Claim :—In the manufacture of incandescence electric lamps subjecting the carbons or filaments or portions to be rendered incandescent in use to the treatment described, that is to say, to variation of the length while raised to incandescence and subjected to a constant electrical pressure for the purpose and by the means substantially as described, also the mechanical arrangements for the purpose described and illustrated in the drawings under several modifications.

3149. "Improvements in incandescent electric lamps." A BERNSTEIN. Dated March 5. 8d. Relates to that type of incandescent electric lamps in which the light-giving carbon is straight or slightly curved and the conducting wires are sealed into the opposite ends of the glass bulb. In lamps of this kind there has always been a certain difficulty on account of the strain produced by the expansion and contraction of the different parts which strain caused the filaments to give out. The glass bulb tends to expand outwards the conducting wire inwards and the carbon tends to lengthen itself as soon as the lamp becomes heated by the current. These different actions are detrimental to the lamp unless their effect on the carbon is counteracted by suitable means. The inventor finds that this can be done by the interposition of a flexible conductor between two different parts of the rigid conductor inside the lamp. For this purpose he makes the conducting wires of platinum where they pass through the glass and where they are attached to the carbon. These two pieces of platinum are connected to each other by means of a flexible strip of metal preferably, copper, which is bent on itself and placed at right angles to the direction of the conducting wires. Claims :—1. In incandescent electric lamps of low resistance connecting the ends of the carbon or light-giving body with the conducting or leading in wires by means of conductors which are flexible in the direction of the carbon, as and for the purpose set forth. 2. The manufacture and use of the improved incandescent electric lamp described and illustrated.

4231. "Improvements in telephone systems." A. M. ROSEBURGH. Dated August 15. 8d. The inventor employs an insulated line or circuit wire which runs round to the stations of the different subscribers in simple circuit, arrangements being made (automatic or otherwise) to switch the subscribers' instruments from the grounded connection to the aforesaid insulated circuit wire. By giving the subscriber a double installation, the instruments of one installation being differentially wound, the subscriber is enabled to communicate through the same lines to two different exchanges or to two different sets of subscribers at pleasure, each exchange or set of subscribers being independent of the other. Claim :—In a multiplex telephone system the combination substantially as set forth with a metallic circuit, including differentially wound telephone instruments, of a branch line connecting the ends of the metallic circuit and telephone instruments located in said branch line.

7544. "Improvements in dynamo-electric machines." H. J. SMITH. Dated June 4. 8d. Relates to the class of dynamo-electric machines employed in generating an intense current of electricity for firing fuses, igniting gas jets and similar uses. In the present invention the inventor has placed the circuit in the top of the casing and has provided a roller and a rod for guiding the rack bar, the object being to remove the circuit breaking key from a point where it is continually exposed to moisture and dirt to a point where it will always be kept dry and accessible for cleaning. The claims are 7 in number.

7860. "Improvements in dynamo-electric machines." S. P. THOMPSON. Dated June 11. 8d. Relates to the construction of simple dynamo-electric machines, and particularly to that kind of machine in which there is a single magnetic circuit, the field magnet being formed preferably in one piece without joint as set forth in the specification of letters patent No. 5122 of 1882. One

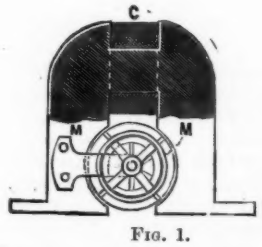


FIG. 1.

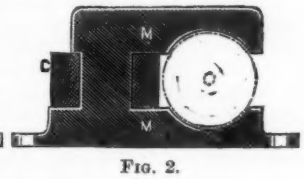


FIG. 2.

of the advantages of the field magnet being thus constructed as a simple magnetic circuit is, as stated in the said specification, that the same castings which serve as cheeks or cores for the electro-magnets can serve also as the bed plate for the machine. The improved machine constructed according to the present invention may be regarded as a modification of the said type of machine, the chief improvement being in the construction of the armature as set forth. Figs. 1 and 2 illustrate the two ways of forming the field magnets of the improved machine, the magnets themselves, M, M, being as aforesaid of great solidity, having great mechanical strength, and possessing the advantage of a magnetic structure without joint. The coils are shown in position at C, C. Figs. 3, 4, 5 and 6 illustrate a method of carrying out the improved construction of armatures : S, S, being the spiders ; A, A, the supporting mantles or cylinders ; W, W, the iron washers ; B, B, the outer layer of insulating material ; D, D, the conductors. In figs. 3 and 4 these are shown as of ordinary insulated wire. In

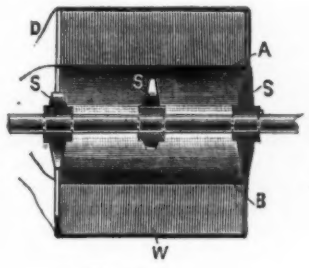


FIG. 3.

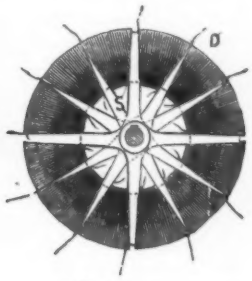


FIG. 4.

figs. 5 and 6 they are shown as constructed of copper tape, T, T. The method of securing the outer conductors by lacing or weaving with thongs, laces, strips, or straps, L, L, is shown at fig. 6. Claims :—1. The improved dynamo-electric machine as hereinbefore described and illustrated in the accompanying drawings. 2. The improved construction of armature frame and core for

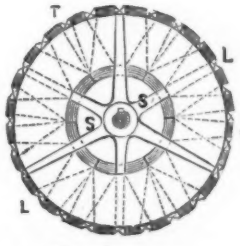


FIG. 5.

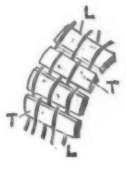


FIG. 6.

dynamo-electric machines, consisting of washers supported on an insulating or insulated cylinder or mantel, or cylinders or mantels held upon spiders, substantially as hereinbefore described. 3. The method of securing the external conductors of an armature for dynamo-electric machines by weaving or lacing the said conductors with insulated or insulating thongs, laces, strips, or straps, as hereinbefore described.

8151. "Improvements in the manufacture of carbons for electrical purposes." J. G. TONGUE. (Communicated from abroad by J. Kirby, of Namur, Belgium.) Dated June 19. 6d. In tar there exists a very fine powder which is held in suspension. This powder is essentially 90 to 99 per cent. pure carbon ; it is therefore the best substance required for the manufacture of electric crayons, carbons, plates, and other forms in carbon on account of its purity. For this purpose according to this invention the said carbon is extracted by means of a solvent, known as tar-naphtha which yields 90 per cent. on distilling at between 150 and 190 degrees centigrade, or with any other suitable solvent such as creosote, heavy oil or light oil or even bisulphide of carbon. By mixing two parts of one of these solvents with one of tar a black pasty compound is obtained. This compound is then poured into a linen or other bag in order to separate by filtration the tarry matter contained therein from the carbon. The former passes through the filtering bag whilst the black paste consisting of carbon is retained in the bag which is then pressed ; and this black paste is afterwards carbonised in a retort. The product is a coke or carbon, and is the material from which the crayons, plates, and other carbon forms for electrical purposes are made. The claims are 5 in number.

8501. "Improvements in portable galvanic batteries." W. L. GATES. Dated June 29. 8d. The main body of the case or vessel in which the battery is mounted is a horizontal hollow cylinder with one flat end formed in one therewith. Another corresponding flat end is fitted to extend a little way into the interior of the main part, and to form an absolutely tight fitting plug therefor. The elements are bedded in pitch, and held by screws which are kept out of contact with the exciting fluid by a covering of pitch. A screw holds one element against one end and a corresponding screw holds the other element at the other end. The conducting wires are attached to the screws. When the removable end or plug is in place, the only orifice connecting the interior of the casing with the outer atmosphere is about the mid-length and connects with an open-ended funnel. The opposite side or lower side of the cylindrical case is provided with legs. The claims are 4 in number.

## CORRESPONDENCE.

### The Marchant Engine.

An examination of Mr. Marchant's patent specifications clearly shows that the endeavour is to work his engine according to Carnot's well-known cycle. That is, the fluid after performing a certain amount of work is first compressed isothermally, then adiabatically, until it attains the pressure and temperature of the boiler. The maximum condition of economy is attained when all the steam is condensed and enters the boiler at boiler temperature. For, if any portion of steam was returned, or forced back, obviously enough no useful work of any kind could be performed by that volume of steam—action and reaction being equal.

Now taking the case of the Marchant engine, and assuming the initial pressure to be 250 lbs. absolute, which seems to be the average pressure at which it is worked—the vacuum being 17 inches of mercury—about 6 lbs. back pressure. Under these circumstances little extra economy can be gained by carrying expansion beyond 16 when steam diminishes to about atmospheric pressure. Now it is well known that the total energy exerted by a cubic foot of steam under the above conditions will be found from the following formula of Rankine, which can by proof, if necessary, be put beyond question :—

$$J D_1 \left\{ t_1 - t_2 \left(1 + \log. \frac{t_1}{t_2}\right) \right\} + \frac{t_1 - t_2}{t_1} L_1 + v_2 p_2.$$

The work of compression or energy spent on the return stroke is given by the following :—

$$J D_1 \left\{ t_1 - t_3 \left(1 + \log. \frac{t_1}{t_3}\right) \right\} + v_2 p_3.$$

In these formulæ $t_1$ $t_2$ = initial and final absolute temperatures respectively ; $t_3$ that of condenser ; $p_2$ = final pressure ; $p_3$ = back pressure ; $v_2$ = volume of steam at $p_2$ pressure ; $L_1$ = latent heat of evaporation of a cubic foot of steam at temperature $t_1$ ; $D_1$ = weight in lbs. of a cubic foot of steam at initial pressure ; and $J = 772$.

From the foregoing it will be found by calculation that the total energy exerted by a cubic foot of steam during its expansion in the cylinder, or cylinders, amounts to 120,443 foot-pounds. Of this 29,248 foot-pounds is lost through compression. Therefore useful or effective work = 120,443 − 29,248 = 91,195 foot-pounds per cubic foot of steam. Total energy supplied to engine = ·546 × 829·1 × 772 = 349,853 foot-pounds. Therefore 91,195 ÷ 349,853 = 26 per cent. for the efficiency of the system.

On reflection it will also be seen that if an engine worked under similar range of temperature having no adiabatic compression, and the feed supplied to the boilers heated by the escaping gases, as, for instance, an ordinary fuel economiser, the efficiency could be considerably increased. In this way the work of compression would amount to only 13,820 foot-pounds, giving an efficiency of (120,443 − 13,820 ÷ 349,853) = 30 per cent. This is the ordinary compound engine working with an economiser, and hence the Marchant engine is by no means a promising one. Assuming that a good boiler would utilise 8,000,000 foot-pounds of the total energy in one pound of coal—1,980,000 ÷ (8,000,000 × ·26) gives ·95 lbs. of coal per hour as necessary *per indicated horse-power*, without taking into account any losses which are unavoidable in the most perfect engine constructed on Mr. Marchant's principle. How then can we accept the statement giving the *effective horse-power* as being obtained with a consumption of a little over half-a-pound of coal per hour ?

Mr. Marchant passes the steam, before its entry into the boiler, through a lengthy and complicated series of transformations or operations, which unmistakably must result in a very considerable loss through radiation alone ; and the number of pumps connected with the engine (notwithstanding causing an additional loss owing to friction of extra gearing) appear to be nothing more, on the aggregate, than an auxiliary condenser in disguise.

Great importance is attached to the action of an air spring, which we are told gives up on the return stroke the energy stored up by compression in the forward stroke. I thought this was a virtue possessed more or less by every elastic substance, and consequently fail to see there can be anything gained by using air instead of an ordinary metallic one ; nor, so long as the principle of conservation of energy holds good that any effective work can result therefrom.

**James Fraser.**

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I have been so impressed by the clearness of the scientific reasoning of Mr. Marchant in the letter you publish from him on page 439 in your last issue, in reply to the quibbling doubts cast upon his invention by many would-be clever people, that I should be much obliged if you would allow me to ask him one question through the medium of your valuable paper in order that one point may be cleared up to my mind satisfactorily.

He says "that the pumps are additional cylinders to the engine." (I have put "are" for "were" in consequence of the immediate context), these being the pumps which put the steam back into the boiler. Will Mr. Marchant inform us whether the pumps, being additional cylinders, allow the steam to do work upon their pistons, and that the steam having done this work flows back at a lower pressure into the boiler which is at a higher pressure, or do the pump pistons perform work upon the steam and force it back into the boiler at the higher pressure ?

The former idea seems to me to be hardly feasible, and if the latter operation is gone through and indicator cards are taken from the pumps, is the power calculated from these added to that calculated from those obtained from the cylinders ?

**Millwright.**

*October 30th*, 1886.

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I have read with much interest the various letters which have appeared in your columns upon this subject ; but hitherto no writer (with the exception of the writer of the article in *Industries*) appears to have made any investigation with regard to the essential principle of the engine, and it is to this that I desire to draw attention. I trust that those readers who have studied the theory of heat will give careful consideration to the following points, and publish the result in your columns :—

(1.) Mr. Marchant has, of course, never pretended to get more work out of a given quantity of steam than has been obtained in the best ordinary practice ; he merely claims to produce his steam *cheaper*.

(2.) The economy (if any) of the Marchant process must be largely due to the fact that the feed is supplied at so high a temperature, and containing so much latent heat, that comparatively little fuel is required to maintain the boiler in a proper working condition.

(3.) It is necessary here to remark that Mr. Marchant claims that his so-called steam feed requires no more power to compress it, and ultimately force it into the boiler, than is necessary for the supply of the ordinary water feed. I invite particular attention to this statement, which Mr. Marchant has also put in another form as follows :—Take a steam tight piston and cylinder containing a little water, heated so that a steam pressure of 100 lbs. per square inch is generated and exerted on the piston, forcing it to the top of the cylinder, then a pressure (neglecting friction) of about 101 lbs. per square inch on the other side of the piston will be sufficient to force it down the whole of the

stroke and on to the water, and so compress all the steam into the water; thus the steam is compressed through the whole stroke and into the water by a force not materially greater than that required to overcome the initial pressure on the piston at the commencement of the down stroke. This result could not be accomplished if no water were present.

(4.) We will now consider the nature of the process, commencing only at that stage whereat the Marchant engine departs from the ordinary practice. Two-thirds of the exhaust steam, at probably a few lbs. above atmospheric pressure, enters the pump, wherein it meets one half of its own weight of water (conveyed there from the surface condenser), say, at a temperature of 70° F. Condensation must at once occur till the water is raised to 212°, or converted into steam. As the pressure, due to the successive action of the pumps, increases, more and more of the steam is probably liquefied, or, rather, it enters the water, but does not lose any of its latent heat beyond that which is required for raising the temperature of the water. Just before the charge is forced into the boiler the pressure will be about equal to that in the boiler, and if the charge were suddenly liberated from this pressure and exposed to the atmosphere, at least a portion of it would immediately fly into steam; consequently it appears that although the charge is, owing to the pressure, in the state of a sort of *elastic liquid*, it is to some extent really a steam feed, and contains a large amount of latent heat. I have made no mention of the air spring, for although it is the means whereby the delivery of the charge is rendered possible, no economical advantage is obtained by its use. As the nature and purpose of this air spring do not seem to be well understood, I may explain that it is merely a cushion of air interposed between the piston of the pump and the steam which is being compressed. It may be regarded as forming a kind of distance piece or medium which enables the steam to be readily forced forward. It is remarkable that when the small air pump which supplies and maintains the quantity of air for the air spring is stopped, the engine at once begins to slow down, and soon, I believe, actually stops, though live steam is full on the engine.

(5.) Assuming statement 3 to be correct, and after making due allowance for the facts mentioned under head 6, the whole question appears to lie in this narrow compass, viz., what is the amount of heat, latent and otherwise, contained in the feed charge, and to what extent does it benefit the boiler by enabling it to work with less fuel? It must be borne in mind that 1 lb. of steam at 212° will heat fully 6 lbs. of water 150°, though it will not convert that quantity into steam. In the Marchant engine 2 lbs. of steam is brought into contact with 1 lb. of water.

(6.) In any comparison of this engine with those of ordinary construction, it must be remembered that in the former we have the friction of the numerous pumps, and also a less vacuum (about 17 inches), while in the latter the exhaust is used to produce, say, 27 inches of vacuum, and to heat the feed water. I understand that Mr. Marchant contemplates obtaining 27 inches of vacuum with the one-third of the exhaust steam, as soon as his appliances are perfected.

**William Granger.**

*November 2nd*, 1886.

[This letter curiously enough contains comments similar to those in our leading columns.—EDS. ELEC. REV.]

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I need only notice what Mr. Massey writes in regard to "Bidder & Halpin's views of this new thing"—he says correctly that it is more than twelve years ago since I saw those gentlemen (several years more) and when I did see them the engine I ran for their inspection was *the compressed air engine* on which I commenced my experiments, and they neither knew of, or to my knowledge heard of, my subsequent action on *steam*.

So that Mr. Massey's expressed "care to have his information well up to date of writing" is both *amusing and expressive*.

I also enclose you the copy of a letter I have written to the editors of *Engineering*, in which I refer to Mr. Kempe's communication in your last issue—and as the time would appear to have arrived, when profitable consideration can be given to the process by which I effect a *steam feed* to the boiler at less *loss* of power than that required to effect the ordinary *water feed*, I enclose you also a copy of my reply to the editors of the *Engineer*, in regard to the necessary attainment by such process of a future economy greatly in excess of any yet recorded.

**R. M. Marchant.**

*November 1st*, 1886.

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Copy of letter to *Engineering* referred to in my letter to "ELECTRICAL REVIEW."

*To the Editors of "Engineering."*
"THE MARCHANT ENGINE."

*London, November 1st*, 1886.

Sirs,—You write that "I insinuate, although I am careful not to say so plainly, that your so-called assumptions are unfounded."

In answer to which insinuation on your part, I answer that in my letter I wrote you plainly "it is therefore no fault of mine that you now write on a false assumption."

You request me "to state definitely wherein I consider your assumption erroneous," and, in compliance with your request, I state that you assume a fulcrum where there may be space, so that no fulcrum could exist, and you so argue on a false basis to a necessarily false conclusion, and I refer you to Mr. Kempe's communication in the ELECTRICAL REVIEW as to the extent of your error.

Having now, at your request, made this statement, I ask you in return to be good enough to inform me what you consider my system to be, "*on which you do not hesitate to record your opinion*," and I ask this because I believe you record such adverse opinion without taking the trouble to put yourself in the intelligent position to form any opinion on the matter, and that you so write in ignorance and to my injury.

You will have the data from which *in your editorial position* you convey *such opinion* to your readers, you can have no difficulty therefore in stating in your next issue what the system is on which you express such an opinion *to my injury*, and as you will receive this letter to-morrow (Tuesday, 2nd November), I am entitled to make this request, and you can have no difficulty in acceding to it, and will feel in honour bound to do so.

Your obedt. Servt.,
R. M. MARCHANT.

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THE MARCHANT ENGINE.

*To the Editor of the "Engineer."*

*November 1st*, 1886.

Sir,—You are good enough to offer space in your columns for discussion on this matter.

In the first place, in regard to the opportunity I promised you "of carrying out a practical test of my engine," I desire to say that I have been waiting the completion of a more perfect exhibition in regard to my possession of a tight and dependable boiler, as the boiler I now use, although reconstructed to the degree of rendering it applicable to such intermediary trials as I have gone in for, in proof of the action of my process, is neither tight nor dependable for such definite and final test as I have promised yourself and others. I submit that my desire to show on a final trial those greater results which are attainable with a perfect application is both a legitimate and wise one.

You say that one horn of the dilemma is, that I have "made a wonderful discovery in thermo-dynamics quite undreamt of hitherto," and you refer to some 20 years ago, and my then opinion in regard to stage pumps. The *necessity* for their application still exists, but I doubtless then exaggerated their service.

As you state, I was at my work within a year or two of the 20 you name; I went to you on the subject of the compressed air engine which I began on, and which I ran with 500 lbs. of air pressure, and with the pumps as cold after hours of running at *such pressure* as when I started. In some *Engineer*, and I think a December paper, of about 16 years ago, you record a test of this engine.

I then went on to steam, and I had very remarkable (3 and 4 to 1) results taken and certified to in regard to what was then my steam feed application. But, although the necessity for the use of air in the application was manifest (for I could not run without it), I was at the time unable either to explain the action or account for the fact recorded, that I ran the engine with a load on the Royal Agricultural Society's brake when *the steam feed was on*, at some 200 revolutions per minute, and that the engine would not even carry the same load *at the same boiler pressure* when the steam pumps were off, and idle, and the water feed on. Unknown to myself and to the operators, these pumps were then *as now* cylinders to the engine.

Shortly after this period my financial position compelled me to go off the line of a perfect engine on my principle, and to apply my then pumps to other engines, and I did so with recorded and

remarkable results. I was then met by *Experts*, who referred to other means of effecting the same economy to these engines, and I was ultimately driven on these grounds to a very expansive action engine, and finally to an exhaust of some 24 inches of vacuum, where I learnt my final lesson.

And what I have so finally learnt is, *how to return a steam feed to the boiler with less* LOSS *of power than is required to do the work of a water feed.* I conclude that a steam feed, under these circumstances, *will be admitted by you to be a desirable attainment*, and in its proportion an advance towards that perfect caloric action which gives those advantages which I state in a practical manner at the end of this letter.

The fact is that you, with other gentlemen, build up your own theory of what I am doing, and then knock down the image you have made yourself, with those more correct and perfect theories which you have in a heap ready to your hand to throw at the image you have constructed for the purpose, not considering that the man who has for all these years had *good experimental evidence of what there was in his work*, is the real *Aunt Sally* who receives the blow intended to shatter the false and imaginary image that has been so set up.

I have, however, to thank you for taking your *shy* in a gentlemanly and proper spirit, and I only regret that all writers are not actuated by the same.

During the many years of my work I have met other very kind and considerate gentlemen, who have taken great pains to convince me why the work I was at could never be done; but I stuck *to proven facts*, although at that time I could not explain them. I have, of course, met many who were very conceited *with a little knowledge*, and some who were very offensive under a still smaller possession, and who have always done me what harm they could.

You will remember that I offered to call on you to explain the process by which I return a steam feed with less *loss* of power than that required for a water feed. I now state a few facts for your consideration.

The steam *is not pumped back*, but *it is put back* by means of the air spring, which is so applied as to remain behind the charge delivered, and to give back to the pump piston on the return stroke the pressure put into it on the forward stroke.

The sensible temperature of the feed is that due to steam of the pressure to which it is finally expanded in the pumps, and *all the work* of putting it back, is first put into the air spring *by* the engine, and then given back by the air spring *to* the engine, so that there is little loss in this respect.

The air spring requires to be kept alive as the motion and heat weaken it, and this is done by a very small air pump which circulates air through the system, the air taking the position due to its gravity. In this case at Bow there is one such air pump for each engine, of 1¼ inch diameter and 3-inch stroke.

Before I grew to comprehend the air action, my valves were frequently so placed that I continually lost the air spring, with the results following such loss, which gradually taught me my lesson. Consequently, until I comprehended this action I was simply blundering towards its attainment.

There are several facts which are not generally considered. Steam leaves its water on account of its inferior gravity; were it heavier it would of course lie at the bottom. Power a little in excess of its pressure will replace the steam on its water. *It is none the less steam* for being pushed back by a power greater than its difference of gravity, for without any further application of heat it will leave its water again when the additional load is removed, and what is obtained by putting the steam back is a more or less elastic water, of which the steam portion is ready to separate itself on the first opportunity. Steam can only be converted into a real liquid by the extraction of the latent heat which made it out of water—that which will expand into steam again by the mere removal of pressure cannot be an actual liquid, for the liquid would require further heat to vaporise it.

There are many things of daily occurrence which will lead to a clearer comprehension of a difference between steam when in the actual presence of water of its own temperature, and of steam when separated from such connection.

Steam separated from its water is lighter than air and floats in it; but in any boiler where you have steam and water with air, the first thing that comes off when the safety valve is lifted is the air in the boiler, showing that in such condition the air is at the top, as being in that case the lightest. There are, of course, many reasons why steam as a vapour cannot be pumped. But I have met engineers who have had experience in what I call the *churning process* of any attempt to pump steam where you have water of its temperature in the pump. You simply play with it, and get no *forward* action; the steam is pushed into its water by a little over its pressure on the forward stroke, and comes out of it on the back stroke.

It is to such condition of steam pushed into water that I apply my air spring, and an elastic charge containing 2 lbs. of steam for every 1 lb. of water is forced through the forward valve by it.

I think in the foregoing you will find a different image from the one you set up to *shy at*, and this is part of the image I am prepared to stand by. I now call your attention in a practical manner to what the effect of returning two-thirds of the steam as feed to the boiler necessarily means.

Take 10 lbs. of water as the best ordinary practice evaporation from 1 lb. of coal.

Take 2 lbs. of coal as the best ordinary practice consumption per H.P. per hour.

From the above we get 20 lbs. of steam consumption per 1 H.P. per hour.

And 20 lbs. of steam at 100 lbs. pressure contain 24,230 units of heat, which, multiplied by "Joule's equivalent" of 772 foot-lbs. per heat unit, and divided by the $33{,}000 \times 60'$, which is assumed as the H.P. unit, gives us 9·44 H.P., or approximately, that 10 H.P. which is frequently spoken of as the result that would replace our existing 1 H.P. could perfect caloric action be accomplished.

The return of all the latent heat cannot be accomplished because water is a necessity to the operation; but two-thirds of the steam has been already returned, and such results have been effected by means of an air spring, and with less *loss* of power than a water feed requires. Such effected two-thirds of 9·44 therefore leaves a necessary 6 to 1 result.

Your obedient servant,

R. M. MARCHANT.

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I desire to draw attention to what I consider to be one or two errors in your recent test of this engine.

At the commencement of the trial the boiler pressure was 250 lbs., and this had been got up and the boiler and surroundings well heated previous to the trial by coal not taken into account by you. Now at the end of the test the pressure was only 125 lbs., hence the engine derived power from coal used previous to the start. In other words, the engine worked, so to speak, with borrowed capital obtained from coal ignored by you, and that to the extent of (250 lbs. minus 125 lbs.) 125 lbs. pressure. To obtain the true consumption of coal enough should have been put on towards the end of the test as would have left the boiler in the same condition as at starting, viz., 250 lbs. pressure. To do this probably about 2 cwt. would have been required and your estimate of the coal used is probably deficient by about that amount.

*The Brake.*

I have read the letter in last week's *Engineering* and also Mr. Kempe's letter in your to-day's issue and I may leave the writer of the former to defend himself; he will probably convince you that the whole of the pull on the balance was due to the particular adjustment of the nuts, N and $N_1$, and the presence of the stop, F, and not at all to the effort of the engine. If this be the case then Mr. Kempe's argument has no weight. However, the whole point about the stop, F, can be easily settled and with *absolute certainty* as follows:—At the test the average pull on the balance was 320 lbs., the average speed 140 revs. per minute, and the average boiler pressure, I suppose, about 200 lbs. Now if the stop, F, be *entirely removed* and the engine be set running at the above speed and with the above boiler pressure, then if the stop, F, did *not* touch during the recent test, obviously the pull on the balance should be substantially as before (viz. 320 lbs.). If, however, it *did* touch, then the pull will be probably a good deal less. Now, with regard to the roller, E, I will show that its presence is absolutely unnecessary; thus: The weight of the brake rests upon the top segment, B, which presses on the circumference of the flywheel. Now what is the effect of this? Why a friction is produced between them, and this friction simply tends to rotate the whole of the brake with the flywheel, but such rotation is resisted by the connections to the spring balance, and the balance shows and registers the pull resulting from this friction and it thus enters into the calculation and is in no way a deleterious friction. In other words, the weight of the brake if unsupported by E, produces a friction which exhibits itself in a useful pull on the balance—a pull additional to that caused by the gripping of the nuts and bolts, N and $N_1$ and C and C. Moral—remove the roller, E, as it does no good and *may* vitiate the results. The only objection to the dead weight of the brake is that it causes a friction on the crank shaft *bearing*, but no more, probably, than would be caused by the pull of a belt if the engine were driving a factory or a large dynamo, hence its trifling effect may be entirely neglected. If the stop, F, and roller, E, be entirely removed the brake will probably give fairly accurate results, except so far as errors may arise if it be not well balanced vertically, that is when the brake and radius bar are carried slightly to the right by the

rotation of the flywheel, there may be a slight preponderance on its right-hand side tending to produce a pull on the balance additional to that caused by the engine. If any stops or supports are required to keep the brake from backlash or from moving too far in any direction, then let them be placed where they are clearly visible.

G. A. W.

*October 29th*, 1886.

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As you were good enough to publish my letter of 27th inst. in your last issue, with reference to my examination of the brake used at Bromley, I now send you a copy of a letter which I have addressed to one of your contemporaries.

**William Downie.**

*To the Editor of "Engineering."*

Sir,—I am much obliged to you for publishing my letters of 25th and 27th inst., but your expression of regret that I did not go more fully into the matter must be my excuse for again troubling you on the subject.

In your article, page 426, October 22nd, 1886, you say: "If, however, the nut, *n*, be tightened down instead of *n'*, the resistance to the engine will be increased, until ultimately the lower brake block would be lifted from the point F, and the work done by the engine would then be accurately measured by the pull at the top of L; the brake, in fact, becoming an ordinary Prony brake." Then, again, in your editorial note, page 447, October 29th, 1886, you say: "What we are concerned with, however, is the condition of affairs when the application of the brake is effected by tightening the nut, *n'*, as was done at the trials to which we referred, the bolt, *n*, being left slack."

Now, as a matter of fact, what was done during my examination of the brake used by Mr. Marchant was to put the load on as has always been done, *i.e.*, by tightening the nut, *n'*, the bolt, *n*, being, as you say, "left slack," and it was under this "condition of affairs" that when I went down into the flywheel pit I found that the brake cleared stop, F, by nearly two inches, and the engine driver assures me that while the various tests were being taken the stop in question was then as it is now; I must therefore repeat what I said last week, that the assumption that stop, F, acts as a "fulcrum" is erroneous; and, as I said before, anyone interested in the matter can verify my statements, and none more welcome to do so than yourself.

WILLIAM DOWNIE, *Managing Director.*
THE MARCHANT ENGINE SYNDICATE, LIMITED.

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### Insurance Companies and Electric Lighting.

I venture to ask for space in your widely read columns wherein to enter a mild protest against what, unless some neutralising influence is brought to bear, must soon become the *prohibitive* rules for electric lighting laid down by insurance companies, and on the due observance of which depends their acceptance of fire risks. That the complete and lasting success of an electric light system depends entirely upon its judicious arrangement no one will dispute, nor that two of the most important factors in such a system are ample carrying capacity of conductors and efficient insulation, indeed, it may be taken for granted that no installation of the electric light can be a commercial success if these conditions are disregarded. Now, I take it that the very precautions which are of necessity involved in the conditions essential to the commercial success of electric lighting are precisely those which go to make it a safer method of illumination than any other, for be the engine never so economical as regards fuel, or be the efficiency of the generator never so high, what avails it if their joint production, the current, is allowed to leak away for want of insulation, or is hampered in the performance of its duty by undue resistance? Now, I do not desire for a moment to imply that there is no need for fire insurance companies to frame, in the protection of their interests, certain rules for the guidance of electric light engineers, the result of non-observance of which will be refusal of fire risks, for I apprehend that having the fear of the fire inspector before their eyes, exercises a most salutary influence in many cases in these days of competition and "cutting," but with all due respect I submit that these rules need not be so arbitrary in themselves, as to leave absolutely nothing to the discretion of either the engineer or his client. I would ask why, if it is desired to light a house with 100 lamps, should the proprietor be forced to use a conductor capable of carrying the current for 200 lamps and costing double the price, or forfeit the privilege of protecting his property by insurance unless at an exorbitant rate of premium? Why should an insulation resistance of 100,000 ohms with its corresponding expense be insisted upon, when with one quarter of this the same immunity from leakage may be insured? By all means let those who can afford the luxury of a 19/12 cable with a couple of megohms insulation resistance for half-a-dozen incandescent lamps enjoy the privilege of having it put in, but why should the less fortunate individual be forced into an unnecessary expense or go without his electric light except as his own insurer. It may be said, Oh! but these rules we lay down are always subject to modification and are never adhered to in their entirety; a margin is always allowed to suit the case and so forth. But I submit that this discretion is entirely in the hands of the fire inspector, from whom, moreover, there is no appeal. I have lately discussed this subject with electric light engineers of sound practical ability, and the experience of one and all has been that they had never yet passed a fire inspection without trivial questions being raised, and equally needless, and in many cases, ridiculous precautions being insisted upon. There is an old story of a wise (?) man whose cat had kittens, for whose accommodation he cut another and smaller hole in the door of the stable where they resided. How many electric light installations I would ask are there in London carried out under fire inspectors' supervision which do not present cases of parallel sagacity. I pause for a reply.

**Resistance.**

*November 2nd*, 1886.

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### Incandescent Lamp Monopoly.

We think it would be very difficult not to sympathise with the object of the meeting held at the Cannon Street Hotel on the 14th ult. and sincerely to thank Messrs. Woodhouse and Rawson for so pluckily taking up the defence of not only themselves and all engaged in this branch of engineering, but, shall we not say, of the general public.

We are strongly of opinion that the Appeal—should it be proceeded with—should be heartily supported not by a few large and influential firms only, but by all those engaged in electrical engineering. We hope, therefore, that the trade generally and also the public, will see this matter in its proper light and hasten to support Messrs. Woodhouse and Rawson in their endeavour to put an end to what may ultimately become a gigantic monopoly.

We ourselves have pleasure in subscribing £25 towards this fund, and will do our best to lay the matter before likely contributors in our district, and we may add that we have every confidence in believing that Glasgow and the north will respond to our appeal, and that, too, substantially.

Although the question of incandescent lamp patents may be looked upon by outsiders as a purely trade question, yet it is the public who in the long run will be the gainers or losers, just in so far as the Edison-Swan Company upholds its so-called patents or Messrs. Woodhouse and Rawson are successful in their contention; and we trust that among the contributors to this fund may be found many names other than those who are members of the trade; and we shall be exceedingly surprised indeed if the latter do not come boldly forward and support Messrs. Woodhouse and Rawson at a time so critical to the wellfare of each individual member.

In conclusion, let us ask what has become of the new departments added to so many businesses a few years ago? We mean their telephone departments. Is it necessary to point the moral?

**Hine and Urquhart,**
*Lately trading as* HENRY BENNETT & Co.

*November 2nd*, 1886.

### Welding by Electricity.

Your issue of October 8th contains a letter from J. B. Duncan claiming to anticipate my invention of electric welding by "something like 16 months."

There is no need of my reminding the readers of the ELECTRICAL REVIEW of what an "anticipation" consists, because it is evident that Mr. Duncan has not duly comprehended the method pursued in my welding process. He says:—"I applied fully 18 months ago the principle that there is a greater electrical resistance at a break than at any other part of a conductor, and consequently increased temperature at that point." Now, there is no such thing as a break in my mode of procedure, the ends of the bars being abutted quite firmly together, and the volume of current used being such that should a break occur or be made during a flow of current, an instant explosion and ejection of fused metal would result and prevent the formation of a good joint. Neither could I effect such a weld by a current capable of simply rendering the "filament of a lamp highly incandescent," and surely Mr. Duncan will not claim that by putting broken platinum wires together and keeping them so placed during the passage of current, he will have a "break" at such contact, having a greater electrical resistance than at any other point of the conductor, when, as he afterwards states, the filament of his lamp is retained in the circuit.

I have nothing to say as to the nature of the ordeal which his filament would have to undergo were he to pass current of sufficient volume to weld the ends of the broken wire when held in contact without a break.

Further, I have no desire to lay claim to any originality in having made the resistance of my circuit greatest where the highest temperature was needed, though Mr. Duncan has almost imputed such a desire to me if he has not ended by making such a claim himself.

I may as well say here that in a few of the notices of my electric welding process which have appeared, slight inaccuracies of statement have crept in, besides a certain amount of theorising as to the part electricity has in the process, which certainly has not emanated from myself.

**Elihu Thompson.**

*October* 19*th*, 1886.

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### The Ferranti Transformers.

Seeing in your issue of the 29th October a paragraph relating to certain electrical apparatus called "The Ferranti Transformers" at the Grosvenor Gallery in use there, we write to say on behalf on Messrs. Gaulard and Gibbs, the patentees of the secondary generators, that the so-called Ferranti transformers are clearly an infringement of Messrs. Gaulard and Gibbs' inventions, and in consequence thereof legal proceedings have been commenced against Sir Coutts Lindsay & Co., Limited.

**Campbell, Reeves & Hooper,**
*Solicitors.*

*October* 30*th*, 1886.

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### Testing Dynamos.

In the article from *Industries* in your last issue, the whole credit for what is described as the best method hitherto devised for testing dynamos, is given to Messrs. Trotter and Ravenshaw.

Will you, therefore, allow me to point out that the method described in all essential details was in use in this school (School of Military Engineering, Chatham), over two years ago, as many as five dynamos of different patterns having been thus tested in the same series against each other, and it not being at all confined to testing machines of the same pattern, although, as a rule, in its practical application to testing new machines for the W.D., those tested at any time are of the same pattern. We have always preferred, however, to keep the circuits of the motor and generator distinct, all measurements being electrical and the joint efficiency of each pair, or the efficiences of each machine, assuming the efficiency as motor to be the same as that as generator being calculated as done by Mr. Trotter.

**P. Cardew.**

*November* 1*st*, 1886.

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### Secondary Generators or Transformers.

In the issue of the 15th inst. of your esteemed journal we read a letter of Mr. Rankin Kennedy pointing out some communications he had made in your issues of the 9th and 16th June, 1883, about some experiments with secondary generators.

We have read these two letters and find that in the first of them there is indeed a slight allusion to the idea of parallel arc in general, but only as a vaguely dropped remark, followed closely by its own revocation. All that Mr. Rankin says on this subject is confined in the following sentence:—

"In parallel arc, however, the secondary generator is a beautiful self-governing system of distribution; but what about the size of conductors for such a system? Prodigious!"

Now, this sentence only proves that in 1883 an idea has passed like a vision the mind of Mr. Rankin Kennedy without having been grasped or comprehended by him, but that vision vanished immediately as "Prodigious!"

Since the date of that letter there have elapsed more than two years, during which period technical publicity has frequently taken the opportunity to occupy itself with full specifications and communications on our new system of distributing electricity, and nevertheless it is only to-day, after having heard of the practical results obtained with our system, that Mr. Rankin Kennedy suddenly reminds himself of having had a similar idea in 1883, which proves that from June, 1883, up to October, 1886, Mr. Kennedy had no clear idea of that idea. But even in the letter of the 9th inst. Mr. Kennedy expresses himself rather vaguely by saying: "I also stated that they (the secondary generators) *could be* successfully worked in parallel arc." If by such sentences the priority of inventions could be anticipated, then indeed the famous French novelist, M. Jules Verne, would have anticipated the priority of a great many inventions of future days by his interesting, fantastical novels.

Besides, without in any way depreciating the value of the experiments to which Mr. Rankin Kennedy refers in his letters, we cannot help thinking that Mr. Kennedy himself is far from having the self-deception that those experiments should have sufficed for the perception of the real means of a self-regulating distribution with transformers, and he, no doubt, will be aware, after having studied our respective specifications, that those highly valuable conditions which alone are rendering apt the transformers for a system of self-regulating distribution and which conditions are laid down in the specification of our patent, have been known neither to Mr. Kennedy nor to anyone before our respective publications.

We may add that the connecting of apparatus in parallel arc is far from sufficing by itself for a rational system of distributing electricity, and a kind inspection of our patent specification, no doubt, would convince Mr. Rankin Kennedy that we not only have "made improvements in the apparatus employed," but that we also are the first who have succeeded, by means of new and rational methods of connecting transformers and by employing parallel arc, in rendering the electric currents self-regulating and reducing to a minimum the size of conductors, the "prodigious" costs of which have so much discouraged Mr. Rankin Kennedy.

**Charles Zipernowsky.**
**Max Deri.**

30*th October*, 1886.